ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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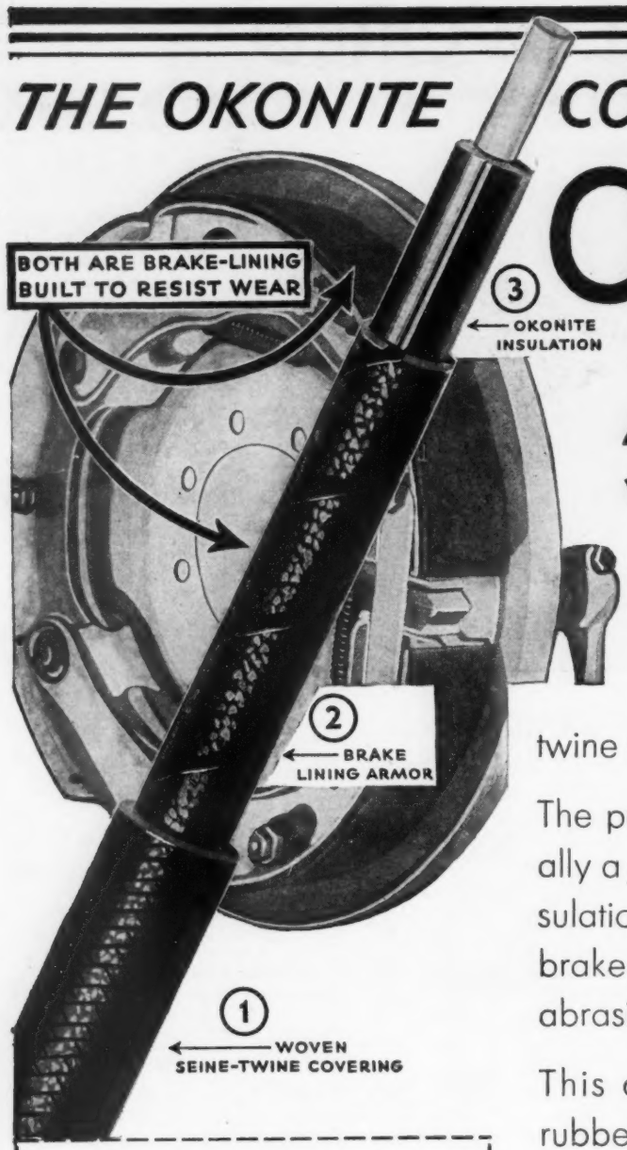

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ELECTRICAL WORLD

FEBRUARY 28, 1931
McGraw-Hill Publishing Company, Inc.
25 cents per copy

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THIS new Deepwater, N. J. station, operated by the American Gas and Electric Company, was especially designed for the use of 1,200 pounds steam pressure at throttle.

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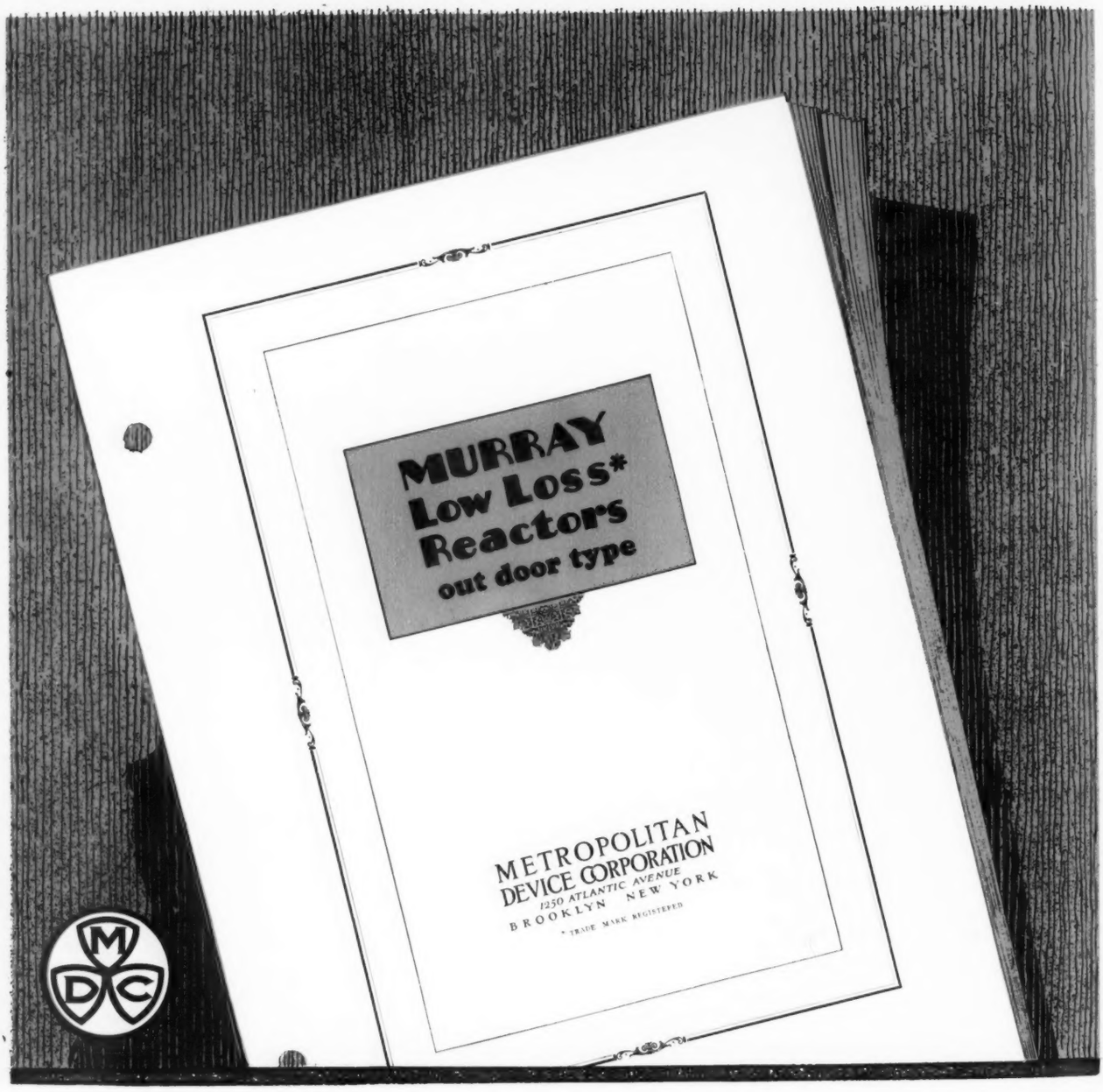

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ELECTRICAL WORLD

for the Week Ending

February 28, 1931

Congress approves Muscle Shoals plan, Hoover to veto?

Plan to insure greater business stability is formulated

If common sense can prevail over fatalism on the one hand and faddism on the other, business will soon emerge from its prevailing depression.

MAGNUS W. ALEXANDER,
President
National Industrial
Conference Board

—**Action on Muscle Shoals bill** by House and Senate would hurl more money into development, already shown to be uneconomical, for control of river flow and transmission of power to limited district at expense of taxpayers. Presidential veto likely—*p. 390.*

—**Tests prove oil-blast theory** and show correlation of recovery voltage rise and oil velocity in circuit breaker performance. Research also indicates action to be independent of current and voltage values—*p. 400.*

—**Complete industrial service** urged upon utilities to round out economic set-ups. Movement, already under way on many properties, will in all probability spread rapidly—*p. 406.*

—**Electricity in South America** develops countries and is expanding rapidly under recent co-ordination of local groups. American capital entered and now speeds the standardization of policies, methods and financing—*p. 420.*

—**Substation costs** were clipped by incorporation of tubular bus on pedestal mounting for 66-kv. structure and omission of lightning arresters and instrument transformers on feeders—*p. 410.*

—**New York City files a tariff** countering Edison company's proposed rate; accepts service charge, but wants some energy included. Company, filing its brief, takes whack at submetering—*p. 393.*

—**Modern outdoor switchyard** just developed for residential community by incorporating decorative principles in street-side wall. Pittsburgh takes the lead in trying to solve a well-known problem—*p. 418.*

—**Investigate holding companies** of all kinds is urgent appeal of W. M. W. Splawn, House committee counsel, who sees federal regulation necessary to right the situation in many fields—*p. 427.*

President Has Muscle Shoals Measure and Veto Is Predicted

THE latest—but probably not the last—Muscle Shoals resolution, agreed on by the conference committee of the two houses of Congress on February 18, as reported last week, passed the House of Representatives on February 21 by a vote of 216 to 153 and the Senate on February 23 by 55 to 28. If President Hoover returns it with a veto, as is freely predicted, it seems unlikely that the required two-thirds vote in each house can be obtained to repass it. The President may, however, subject it to a pocket veto as President Coolidge did the similar resolution in 1928.

The principal speech against the acceptance of the conference report was made by Senator Bingham of Connecticut, who said: "Government ownership to my way of thinking is contrary to the interests of the United States, contrary to the theory on which our government was founded and contrary to the principles on which we have become a great and prosperous nation." Senator Johnson of California, Senator Dill of Washington, Senator Harris of Georgia and Senator Black of Alabama supported the resolution.

The resolution involves an eventual federal expenditure of $47,000,000 for a 200,000-hp. hydro plant at Cove Creek and additional equipment at Muscle Shoals, not including possible outlay for transmission lines from the existing government plants.

The House conferees issued a statement saying that they had accepted the Senate joint resolution without amendment, but only as an alternative, and that its provisions cannot, under any circumstances, become effective for a period of twelve months after the passage of the act, during which twelve-month period the President of the United States will have authority to lease all of the Muscle Shoals property for private operation of the nitrate plant for fertilizer manufacture, and if a lease can be made, then for all practical purposes the resolution can never become effective.

▼

Scope of Jurisdiction of Federal Board Argued

MEMBERS OF THE LEGAL STAFF of the Federal Power Commission are busy digesting the testimony taken at the recent hearing in the New River case and are running down the various legal points that have been raised. One of these is the extent of the jurisdiction conveyed in Section 23 of the water-power act. Counsel for the Appalachian Electric Power Company contends that it conveys no jurisdiction over non-navigable tributaries of navigable streams further than to preserve the navigability of the main river. This led Commissioner Marcel Garsaud during the hearing to inquire if navigation could not be protected by the War Department through the act of 1899 which empowers it to remove any obstruction to navigation. Creswell N. Micou, an attorney representing the power company, answered in the affirmative, and Commissioner Garsaud then remarked: "If this commission is to limit its jurisdiction to the preservation of the interests of navigation and those interests are preserved through an existing act, administered by another agency of the government, then there hardly is need for this commission to issue a minor-part license."

Commissioner Garsaud asked Mr. Micou if he would hold that the jurisdiction of the commission over a navigable stream is limited to specifying regulations for the protection of navigation. Mr. Micou hesitated to cross that bridge until he comes to it. Commissioner Garsaud then asked: "If we assume that the sole interest of the government is navigation in taking jurisdiction even over the navigable streams in applications of this character, why has this particular power been delegated to a new agency of government?" In his answer Mr. Micou said: "It apparently was recognized that a water-power development structure involves a great expenditure and its modification or demolition would involve large expenditure and great loss. The question of water power in navigable streams was dealt with in the act of 1906 and in the act of 1910, but neither provides for a permanent license. They are revocable. They were recognized as not furnishing a fit basis for the protection of the capital required for a hydro-electric development."

These excerpts from the colloquy at the hearing give an idea of the trend of the thought in the matter of jurisdiction. Though the commission would not hear the Popular Government League, it did give it permission to file a brief, contrary to the statement made in these columns last week. One will be prepared for the league by C. A. Russell, former solicitor for the commission.

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POPE STARTS DYNAMO

—Wide World Photos.

Pope Pius setting in motion the new 800-hp. Diesel-engine station which furnishes light and power to the Vatican

▼

Performance Bond for Hoover Dam, $5,000,000

A PERFORMANCE BOND of $5,000,000 will be required of the contractor for Hoover Dam, according to an announcement just issued by the Department of the Interior. The bonding rate will be $16.87½ per $1,000, which is about 25 per cent lower than that charged on the San Gabriel Dam, near Los Angeles. This would amount to $923,175 if the contract should be for $55,000,000 and would be charged against the job by the contractor.

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Arizona Files Its Brief Against Hoover Dam

DECLARING THAT ITS SUIT is not against the United States but to enjoin a federal officer from invading state rights under cover of an unconstitutional enactment, and that this enactment cannot be justified as an exercise of power under the commerce clause to improve navigation nor as an act to reclaim public land nor as a flood-control measure, the State of Arizona filed with the Supreme Court on February 21 a brief defending its claim of right to prosecute its original suit against the Secretary of the Interior and six interested states to prevent

the completion of the Hoover Dam project under existing compacts. The brief is in opposition to a motion to dismiss the state's bill of complaint made on behalf of Secretary Wilbur and alleging contrary facts.

▼

Vermonters Feel Pulse of Electrical Progress

RECENT PROGRESS in regulation of utilities, in scientific research and in engineering economics was recounted at the meeting of the Vermont Electrical Association at Burlington on the evening of February 20, President C. A. Slayton of Morrisville occupying the chair. Chairman H. B. Shaw of the Vermont Public Service Commission pointed out the trend toward obtaining satisfactory valuations of utilities through the employment of engineering experts by the commission with the co-operation of the companies. E. L. Manning of the General Electric research laboratory, Schenectady, outlined recent developments in electron tubes for control and transmission applications. Howard S. Knowlton, New England editor of the ELECTRICAL WORLD, spoke briefly upon economic problems faced by the power industry.

▼

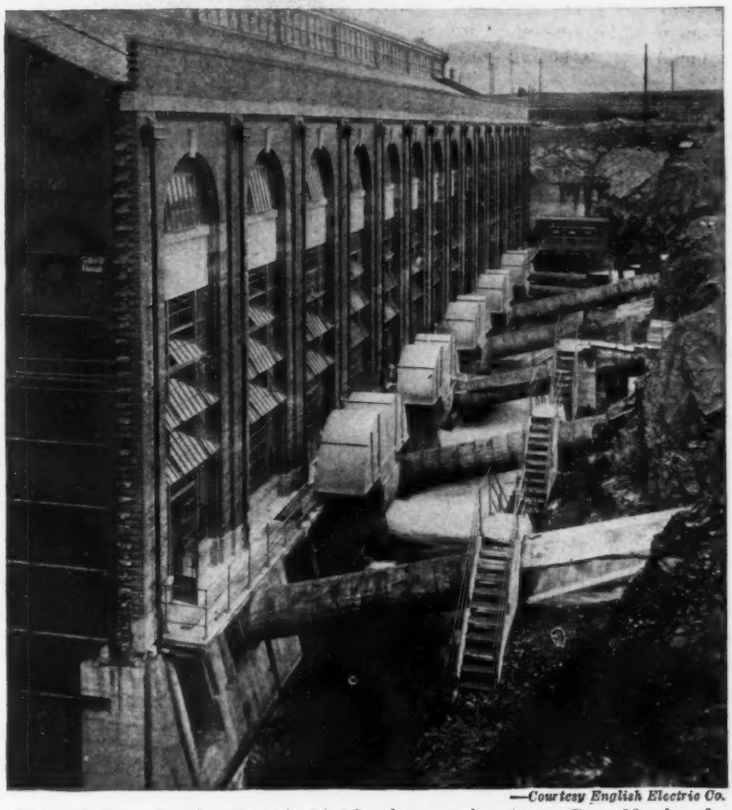
Practical Programs for Approaching Conventions

LATEST PRACTICES on 66-kv. underground construction and progress on cable design for submarine operation at 110 kv. are among the more important subjects to be presented at the annual meeting of the Engineering Section of the Northwest Electric Light and Power Association at Wenatchee, Wash., March 18-20. Radio interference and progress in fishway construction will be other topics.

BUSINESS MATTERS ONLY will this year occupy the annual convention of the Oklahoma Utilities Association, to be held at Oklahoma City on March 10-12, the customary entertainment program being omitted. President Jones of the N.E.L.A. will be a chief speaker.

ENGINEERING PROBLEMS allied with transmission and distribution will engross the annual meeting of the Engineering Section of the New England Division, N.E.L.A., at Boston, March 5 and 6. A. H. Kehoe of New York, H. H. Spencer of Boston and S. W. Stoddard of Lawrence, Mass., will speak on timely topics on Thursday, and L. A. Hawkins, General Electric Company, will give a dinner address on "Whither the Electron?" On Friday D. S. Boyden of Boston, H. W. Moses of Boston and C. W. Franklin of New York will be heard from.

GREAT BRITAIN'S LARGEST HYDRO PLANT



—Courtesy English Electric Co.

At Lochaber, in the Scotch highlands, not far from Ben Nevis, the British Aluminium Company has built a hydro-electric plant, with a present installation of five main 9,600-hp. Pelton waterwheels (made by the English Electric Company) and two subsidiary 1,250-kw. generators, also water-driven. A 15-mile tunnel conveys water from Loch Treig. Eventually this 650-ft.-head plant will yield 120,000 hp.

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Westinghouse Has New Merchandising Plan

A COMPLETE REORGANIZATION of the merchandising department of the Westinghouse Electric & Manufacturing Company to unify its sales efforts and to broaden and make more flexible its activities is announced by C. E. Allen, commercial vice-president. The merchandising department under the new arrangement will be responsible for all products sold for the home, which at present include refrigerators, radio receivers, ranges, heating appliances, fans, vacuum cleaners and water heaters. Farm lighting and water systems and, for certain applications, micarta will come under the jurisdiction of this department at a later date.

Power and Regulation in State Legislatures

ALABAMA.—A thorough legislative investigation of rates charged by utility companies in Alabama for light and power and a study of their tax valuation and rate-making structure is proposed in a bill introduced in the Lower House by Representative Kelly of Talladega. The purpose is to determine the property valuations of the utility companies, on which their rates are based, and compare them with property valuations upon which the companies pay taxes.

ARIZONA.—A bill to set up a board of survey of all utilities and to investigate all utilities has passed the Senate.

CALIFORNIA.—A measure designed "to prohibit the sale of certain articles and appliances by certain public utilities, municipal corporations, districts or public corporations" has been introduced into the Senate. It

would prevent merchandising by any gas or electric company of "any article, commodity or appliance except such as may be necessary for use in the conduct of its business as a public utility."

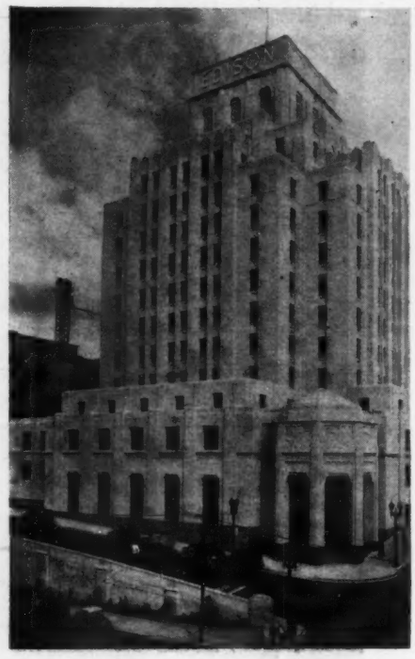
INDIANA.—A few among the flood of utility bills introduced in the House are one requiring a referendum before municipally owned utilities may be leased to private corporations, one permitting the Public Service Commission to employ a permanent tax and rate attorney, one eliminating the authority of the commission over publicly owned utilities and permitting the establishment of such utilities without a certificate of convenience and necessity, and one directing the commission to reduce all utility rates 10 per cent by April 1 next. The proposed tax ranging from 10 cents to 65 cents a pole on transmission systems along public highways was killed by indefinite postponement when it came from committee. The bill proposing a tax of 1 cent a kilowatt-hour on energy selling for 2 cents or more and a tax of 0.5 cent on energy selling for less than 2 cents is meeting with increased opposition owing to realization that the public would have to pay the tax.

IOWA.—The House has adopted by 76 to 23 the Simmer bill authorizing payment for municipal utility plants from future earnings, after four days' debate. Attempt to amend the bill by requiring submission of rates, terms of contract and cost to a referendum was defeated. The author of the measure added a provision requiring a vote of the people on establishment of a municipal plant.

KANSAS.—A bill intended to compel public utility companies to pay license fees sufficient to maintain the Public Service Commission was defeated in the Senate last week only to be passed in the House on the same day by 81 to 15 and sent back to the Upper House. Charges of undue zeal to defeat this bill are made against the utilities, Governor Woodring denouncing the "public utilities lobby" emphatically. A bill has been introduced in both houses to regulate holding companies. It is patterned after the 1930 New York law.

MASSACHUSETTS.—Utility companies came in for criticism for their alleged high rates at a hearing before the legislative committee on power and light on bills to give the State Department of Public Utilities authority to regulate holding companies so as to insure reasonable rates. "If something is not done this year," Representative Birmingham, author of one of the bills, said, "and the monopolies come in here opposing these measures for proper control, next year the Legislature will be forced not only to furnish greater

NOW IT IS LOS ANGELES



February 24 the Pacific Coast's turn for an imposing new office building came with the occupancy of the Southern California Edison's thirteen-story stone and terra cotta structure. It is partly arc-welded.

▼

facilities to allow municipalities to go into the business but almost request them to go into the business of furnishing electricity to their people."

MINNESOTA.—Changes in the regulation and taxation of electric light and power companies are under consideration. One proposal is to place these utilities under the supervision of the Railroad and Warehouse Commission. Another would change the basis of taxation from the present property tax to gross earnings, as other utilities in the state are taxed. Bills covering these changes will be introduced in both houses. Another bill is meant to clarify the meaning of "surplus power" in the existing act permitting municipalities to sell such energy outside city limits.

NEBRASKA. — The House has passed by an almost unanimous vote a bill which authorizes the board of any irrigation district to develop water power in connection with the entire project and to sell or lease it to persons, corporations and for municipalities, the revenue arising to be used for the payment of expenses of the district. The Senate standing committee has killed the Wherry bill authorizing cities of the second class and villages to fix maximum rates for gas and electric companies operating under franchise and requiring such rates to include service charges, meter charges, penalties for delinquency and all other charges.

NEW HAMPSHIRE.—A Senate bill has been introduced "to alleviate unemployment by expediting the construction of hydro-electric plants" by exempting from taxation new plants of this kind for a period of five years. A bill to forbid the export of electric power across state lines was killed in the Senate by fifteen to three.

NEW YORK.—Assemblyman Slater of Rochester has reintroduced his two bills of last year, one amending the general city law and the other the county law in relation to the establishment of boards of electrical safety and the licensing of master electricians. Following a conference over water-power legislation held at Albany this week, in which Governor Roosevelt, all the members of his St. Lawrence Power Development Commission and legislative leaders of both political parties took part, the Governor announced that a bill to set up the proposed state power authority probably would be ready within a week. Julius H. Cohen, a member of the St. Lawrence commission, submitted a tentative draft of such a bill.

NORTH CAROLINA.—A proposed tax on power of 2 mills a kilowatt-hour is being bitterly opposed. Before the Senate finance committee P. A. Tillery of Raleigh, vice-president Carolina Power & Light Company, said the tax "would utterly destroy the power companies in North Carolina." Representatives of other power companies made similar statements.

OKLAHOMA.—House bill 124 as originally introduced provided for a tax of $1.50 per $1,000 upon the capital stock of foreign and domestic corporations doing business in Oklahoma, but did not change the present law, which exempts public utility companies from paying this tax. This bill, however, was amended in committee to make the tax apply also to public utility companies and was reported favorably and then referred back to the committee for further hearing. Another committee reported favorably a bill prohibiting public service corporations from selling merchandise and another bill decreeing that the Corporation Commission shall fix rates on public service corporations on basis of value fixed by the State Equalization Board.

OREGON.—In its attempt to translate into law the "mandate of the people" as interpreted by the Governor, the Legislature has considered no less than ten bills pertaining to water appropriation, power development and utility regulation, with as many amendments and counter proposals. At the end of its normal 40-day session, on February

20, the "power program" was still in a state of flux with the outcome somewhat in doubt as the legislators faced overtime at their own expense. Several of the bills were, however, in a form generally acceptable, and it is expected that most of the principal ones will be passed during the first extra week. In the hands of the Governor were the bill to abolish certificates of convenience and necessity, a bill giving incorporated towns certain powers in acquiring water rights and a bill which aims to exempt Portland from compliance with certain provisions of the federal water-power act. At the same time a new bill providing for a certificate of convenience and necessity in towns of 2,000 population and less was introduced in the House. Part way through the legislative mill are the three main so-called administration power bills. One changes the form of the Public Service Commission to a one-man body and attempts to make that man in effect an advocate of the public interest; one is a new water appropriation measure modeled after the federal water-power act, with which it is said to conflict in many respects, and one is the provision for the formation of utility districts, intended to make the recently passed constitutional amendment operative. Each of these, after amendment and counter-amendment, has passed one house and is on the program of the other for early consideration. In addition, bills in each house make possible development by the California-Oregon Power Company of a site in Oregon on the Klamath River which the company would have to abandon if it were forced to develop the site under the currently proposed water-power act.

PENNSYLVANIA.—Testimony of President Atterbury of the Pennsylvania Railroad before the Senate committee investigating the Public Service Commission on Tuesday was the chief event in the legislative situation as this affects utilities. Mr. Atterbury denied asking or accepting favors from politicians, though admitting freely that he had conferred with Commissioner James S. Benn and other public officials along with utility leaders and with financiers. The committee's chief counsel, Charles J. Hepburn, has given it as his view that the Public Service Commission, acting with the Attorney General, has ample power to regulate the securities of utility corporations, though it could not do so without such co-operation. The Governor had not appeared before the Senate committee when this was written and was about to appoint three "observers" to sit with seven assemblymen selected to conduct the separate investigation fathered by the House. The Governor said this inquiry would begin in a few days.

SOUTH CAROLINA.—Representatives of power companies appeared before the House ways and means committee to protest against a bill placing a tax of 0.5 mill upon each kilowatt-hour of hydro-electric power generated in the state. The spokesmen pointed to the danger of such legislation crippling these companies. Counsel for the Lexington Water Power Company said that such a tax might mean that the company could not continue to operate the Saluda River plant. Nevertheless, a favorable report on the bill was made.

TEXAS.—The creation of rural electric power, light and natural-gas districts is authorized in a proposed amendment to the constitution introduced in the Senate. Bonds would be issued upon the value of the lands for the construction of the plants. Governor Ross Sterling has expressed himself as favoring the public utilities regulatory bill which provides for a fact-finding State commission. Under its provisions all cities would have the right to regulate rates of utilities within their boundaries and to conduct rate researches. Appeals could be taken to the state commission.

WEST VIRGINIA.—Although the Senate bill dealing with water power has not at this writing been reported from the judiciary committee of the Senate, favorable action has been taken on the companion House bill. About ten important changes are proposed.

WISCONSIN.—The administration power program was supported by the Legislature last week when both houses engrossed resolutions calling for constitutional amendments permitting the state to go into the public utility business and the Assembly engrossed the Perry bill to create power districts in which municipally owned plants may co-operate in the supply of power.

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New York Files a Tariff; Company Hits Submetering

BRIEFS WERE FILED last week with the New York Public Service Commission as the last act of the disputants in the rate hearings over the schedule filed by the New York Edison companies.

Corporation Counsel Hilly for the city filed a proposed temporary single-rate "promotional" tariff prepared by the municipal experts which, he said, would at once effect a saving of $3,702,652 for residential consumers and one of about $14,711,317 for commercial customers. This rate would retain the customer charge of 60 cents a month but would supply a maximum of 5 kw.-hr. of energy in return. For the next 25 kw.-hr. the rate would be 6 cents, for the next 75-kw.-hr. 5 cents and for the next 900 kw.-hr. 4 cents. The coal surcharge would be eliminated.

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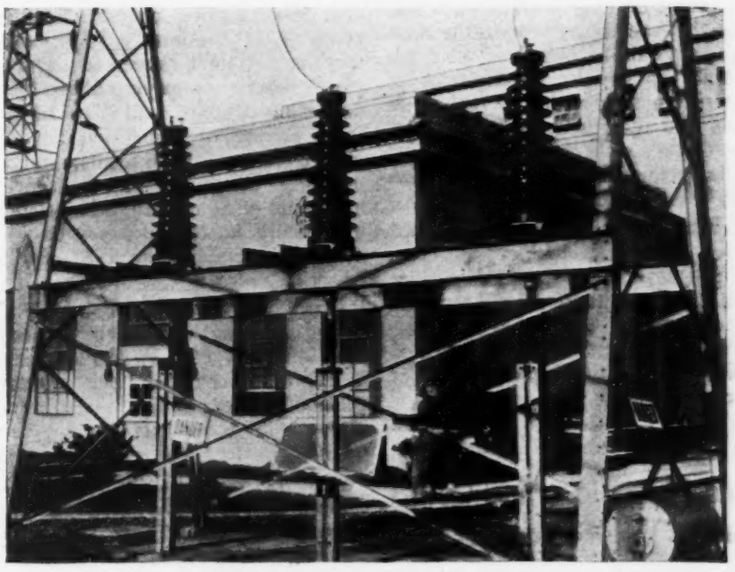
CALIFORNIA'S 60-KV. UNDERGROUND CABLES



The first 60-kv. cable installation on the Pacific Coast, recently made by the Pacific Gas & Electric Company, consists of three single-conductor cables with one spare run in fiber ducts underneath the Newark substation to form a 350-ft. end section of overhead line. With the six 110-kv. oil-filled barrier-type terminals, they were manufactured by the General Cable Corporation.

NEW SKYSCRAPERS OBSCURE OLD AS SEEN FROM NEW YORK BAY

—R. I. Nesmith

Find the Woolworth Building he who can in this latest illuminated view of New York's ever-changing sky line. With no intentional rudeness, the Bank of the Manhattan Trust Company has stepped (as seen from this angle) directly in front of the once-dominating center-front structure.

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William L. Ransom, utility counsel, summarized the benefits, as the companies see them, of their proposed schedule of 5 cents plus a customer charge of 60 cents a month. He discussed submetering at some length and charged that such opposition to the companies' proposals as had developed had been built up by the beneficiaries of submetering masquerading as real estate interests and that their threatened loss of profits on resale of electricity had been disingenuously made to figure as "double-crossing the poor."

The Real Estate Board of New York also filed a brief, attacking the company's proposal. It suggested a service charge of 30 cents a month and an energy charge of 6 cents a kilowatt-hour for the first 1,000 kw.-hr., 5 cents for the next 2,000 and 4 cents for any excess.

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Rate Reductions and Complaints West and East

ANSWERS HAVE BEEN FILED by the Pacific Gas & Electric Company and the San Joaquin Light & Power Corporation with the California Railroad Commission to complaints made by the city of Fresno about rates in which it is alleged that the utilities are discriminating against Fresno. The companies say that no just cause of action has been shown.

A GENERAL CUT effective March 1 in light and power rates throughout western Washington, outside Seattle, to reach $251,000 annually, is proposed by the Puget Sound Power & Light Company. Users now paying above 6½ cents per kilowatt-hour will pay 6½ cents, those paying 6½ cents will have their charge reduced to 6 cents, and those paying 6 cents will pay 5½ cents. A basic rate of 5½ cents will be established universally in territory served by the company some time in 1932, President Leonard states.

RATES TO COMMERCIAL USERS of alternating current have been reduced by the Columbus (Ohio) Railway, Power & Light Company to the amount of $400,000 a year. The 6-cent top rate now applies to only 50 kw.-hr. instead of 100 kw.-hr., and there are similar reductions down through the tariff.

CONTENTION OVER WASHINGTON (D. C.) electric rates still goes on, notwithstanding the Potomac Electric Power Company's demonstration in newspaper advertisements that its 4.2-cent price is lower than residential rates in 49 other American cities with populations of 150,000 or over. Final negotiations between the company and the commission are set for March 2.

Pittsburgh Meeting of A.I.E.E. Next Month

DISTRIBUTION AND PROTECTIVE DEVICES will be leading topics at the regional meeting of the American Institute of Electrical Engineers to be held in Pittsburgh on March 11-13. In addition, a number of selected subjects will be treated. The papers listed for the five technical sessions are as follows:

Wednesday, March 11, *Morning.*—"Burn-off Characteristics of Low-Voltage Network Cables." G. Sutherland and D. S. MacCorkle; "Arcs in Low-Voltage A.-C. Network Cables," J. Slepian and A. P. Strom; "Reignition of Metallic A.-C. Arcs in Air," S. S. Atwood, W. G. Dow and W. Krousnick. *Afternoon.*—"Vertical Networks in Metropolitan Office Buildings," A. H. Kehoe and Bassett Jones; "The Primary Network," R. M. Stanley and C. T. Sinclair; "Operating Experience with Philadelphia A.-C. Network," H. S. Davis and W. R. Ross; prepared discussions.

Thursday, March 12, *Morning.*—"Present-Day Grounding Practices," committee, C. A. Powel chairman; "Reactance of Transmission Lines with Ground Return," J. E. Clem; "Fundamental Basis of Distance Relaying," W. A. Lewis; "Power-System Voltages and Currents Under Fault Conditions," R. D. Evans and S. H. Wright; "Simultaneous Faults and Six-Phase Transmission," Edith Clarke. *Afternoon.*—Student session, addressed by President Lee.

Friday, March 13, *Morning.*—"Conversion and Distribution of General-Purpose D.-C. Power in Large Industrial Plants," R. D. Abbiss and D. C. West; symposium on interconnection between utilities and industries, G. E. Dignan, R. L. Kirk, F. O. Schnure, A. Hoefle and W. T. Woodmancy. *Afternoon.*—Two papers on industrial power applications in annealing furnaces and dairy plants respectively; from papers in field of communication.

Scattered Happenings in the Electrical Sphere

United States

ANNOUNCING THAT THE Pennsylvania Railroad will speed its hundred-and-seventy-five-million-dollar program of construction in the effort to complete it within two and a half instead of four years, President W. W. Atterbury lists as the first of seven large projects the "electrification of the remaining portions of all the lines of track between New York and Washington, including electrification of the entrance to Potomac yard."

WASHINGTON STATE'S SUPREME COURT has dissolved the restraining order secured by the Landreth Brothers Lumber Company, Wenatchee, which had prevented the Puget Sound Power & Light Company from starting work on the west section of the Rock Island Dam. (ELECTRICAL WORLD, February 7, page 259.)

LATE REPORTS to the Oregon State Engineer say that the waters of Klamath Lake and tributaries have diminished approximately 50 per cent in twenty years, owing mainly to the felling of timber and decrease of rainfall. Pessimistic predictions regarding the water-power possibilities of this southern Oregon lake, which have led to rivalry by would-be developers, are now being made.

IMMEDIATE DEVELOPMENT of the Beebe Island (N. Y.) water power at a cost of about $800,000 was decided upon at a meeting of the directors of the Beebe Island Power Corporation in Watertown recently. This action will, it is said, automatically cancel pending litigation and a 10,000-hp. development will be finished within the year, the promoters say.

A 66-KV., 70-MILE TRANSMISSION LINE from Falfurrias, in the Gulf Coast district, to the Rio Grande Valley system of the Central Power & Light Company, San Antonio, Tex., is announced by President E. B. Neiswanger of that company as a part of 1931 expansion. Its construction will give the utility a completely interconnected transmission system in south and southwest Texas. A 14,000-hp. hydro-electric plant will be built on an irrigation canal near Eagle Pass, on the Rio Grande.

THE ALDRED UTILITY INTERESTS plan to construct two additional high-tension transmission lines to connect Baltimore with the hydro development progressing at Safe Harbor. These lines will be constructed on separate rights-of-way. The first, to be known as the Westport line, will be completed early next year. The second, to be known as the Riverside line, will probably be constructed a year or two later. The first will pass west of Baltimore to a new terminal substation near Westport; the second will pass east to the site of the proposed Turners steam station.

TWO FAVORABLE RULINGS came to the Attorney-General of Connecticut last week in his fight against the mandamus order of the Superior Court more than a year ago requiring him to take action on the removal of the Public Utilities Commission from office for alleged neglect of duty. He has been granted an extension of time in which to file the complaint from March to May, and the demurrer of the original complainant, Prof. Albert Levitt of Redding, to the petition for a new trial has been overruled.

AMONG CONSTRUCTIVE WORK accomplished at the recent midwinter meeting of the Commercial Section, Pacific Coast Electrical Association, held in Los Angeles, was the indorsement of a three-wire cable for range wiring to reduce the cost. A move was started to determine the possibilities of utilities capitalizing range wiring to facilitate sales. Portable wiring for renters likewise is to be investigated.

JOHN W. DAVIS of New York, former Ambassador to Great Britain and Democratic candidate for President in 1924, will serve as counsel for the Senate in the coming quo warranto proceedings to test the right of George Otis Smith to membership on the Federal Power Commission. A second counsel may be associated with Mr. Davis.

TEN-MINUTE TALKS on 1930 central-station engineering by ten light and power executives, papers on steam turbines, lightning arresters, radio interference, apparatus, inductive co-ordination and other present-day topics, with "round tables" on meters and engineering problems, made up the program for the annual engineering council of the North Central Division, N.E.L.A., held at Minneapolis on February 23 and 24.

CLOSING OF THE Bagnell Dam, on the Osage River, has been announced by the Union Electric Light & Power Company of St. Louis, and the waters will now slowly fill the immense reservoir, the time required depending largely on the amount of rainfall in the next three months.

BY A VOTE OF THREE TO TWO in the Portland (Ore.) City Council — the Mayor and one commissioner dissenting —an ordinance providing for a contract with Carey & Harlan, consulting engineers, for an investigation of the possibilities for a municipal power system was passed last week after much controversy. The fee for the investigation is $25,000. The contract calls for investigation of several specific sites on the Columbia and Deschutes Rivers.

Canada

APPROVAL OF THE PROPOSAL to develop 400,000 hp. by diverting the flow of the Saskatchewan River into Lake Winnipegosis, thence through Lake Manitoba and the Dauphin River to Lake Winnipeg, will be asked of the Manitoba Legislature at the present session, according to Premier Bracken. The project, he said, would be within 140 miles of Winnipeg, on the Dauphin.

REJECTION OF THE Niagara Falls treaty by the foreign relations committee of the United States Senate has caused some disappointment in political circles in Ottawa. The Parliament of Canada has already approved the treaty, and it needed only the action of Congress to make it effective. Canadian authorities were hopeful that the permitted "experimental" diversion of 20,000 sec.-ft. more would have established that further quantities of water can be diverted from the Falls without injuring their scenic qualities.

Coming Meetings

New England Division, N.E.L.A.—Engineering Section, Hotel Statler, Boston, March 5 and 6. Miss O. A. Bursiel, 20 Providence St., Boston.

American Institute of Electrical Engineers — District meetings, Pittsburgh, March 9-13; Rochester, April 29-May 2. F. L. Hutchinson, 33 W. 39th St., New York.

Oklahoma Utilities Association—Oklahoma City, March 10-12. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Pacific Coast Electrical Association—Engineering Section, Fresno, Calif., March 11-13. K. I. Dazey, 447 Sutter St., San Francisco.

Illinois State Electric Association — Springfield, Ill., March 12 and 13. G. W. Schwaner, 205 Illinois Mine Workers Bldg., Springfield, Ill.

Artistic Lighting Equipment Association—New York, March 16. C. L. Benjamin, 420 Lexington Ave., New York.

Northwest Electric Light and Power Association — Commercial Section, Spokane, Wash., March 16-18; Engineering Section, Wenatchee, Wash., March 18-20; Accounting Section, Salt Lake City, April 13 and 14. B. Snow, 1208 Spalding Bldg., Portland, Ore.

Southeastern Division, N.E.L.A.—Vinoy Park Hotel, St. Petersburg, Fla., April 1-3. C. M. Kilian, 508 Haas-Howell Bldg., Atlanta, Ga.

Arizona Utilities Association—Biltmore Hotel, Phoenix, April 8-11. J. S. Arnold, 300 West Washington St., Phoenix.

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 10. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

Missouri Association of Public Utilities —Excelsior Springs, Mo., April 16-18. F. D. Beardslee, 315 N. 12th St., St. Louis.

Southwestern Division, N.E.L.A.—Mineral Wells, Tex., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Electrochemical Society — Hotel Tutwiler, Birmingham, Ala., April 23-25. C. G. Fink, Columbia University, New York.

Lincoln Electric Company

Welding the Skyscraper

Taller and taller rise successive ventures in this field. Electric arc welding of buildings is proving to be not only noiseless but strong. Tomorrow the clamor of the riveter in cities already overburdened with noise may be but one more half-forgotten horror of the past.

EDITORIALS

L.W.W.MORROW
Editor

Co-operation for stable business

A SEARCHING analysis has been made to find the cause of the business depression of 1930 in order to educe the principles that, followed, will prevent a recurrence of the calamity. These are stated in the "Platform of American Business" published as a supplement to this issue of the ELECTRICAL WORLD.

These general principles should be applied to each individual business, to group business and to the total national business, and the way to start the program is to check present practices and then strengthen weak spots. If every electrical business executive and every electrical business will do this, there is every reason to believe that greater business security will be established in the electrical industry. If other industry branches follow the same program, the national business structure will be improved.

It will be granted that to become effective a program must be applied by an executive. In our form of political and economic organization there is no generally acceptable method for placing executive authority in the hands of an individual politician or business man. Both the political and the economic dictator are abhorrent to our ideals. There remain, therefore, only the co-operative acts of many individuals as the available process for stabilizing business. This procedure is slow, cumbersome and inefficient, yet it can be made effective if applied over a period of time.

Under the existing conditions the first step in business stabilization is educational—the principles upon which sound business should be based should be enunciated so that all may be informed. The second step is for each business executive to apply these principles to the enterprises with which he is associated. The third step may well be a stiffening of programs of the trade associations to arrive at better discipline and a better informed procedure. And a final step may well develop into a business general staff with an able secretariat whereby both information and power will be centralized to check serious national business trends that might result in a recurrence of business depression.

The electrical industry is dependent upon national business for its success. It is a new and closely knit business and abounds with forward-looking executives who have national service in mind. It has already done much to stabilize its business practices and can be counted upon to do more. It believes in co-operation and in having a program, and it is to be hoped that it will go still further to help itself and help all business by applying the principles of the "Platform of American Business" directly and effectively. There is all to gain and nothing to lose.

Wanted: a survey of potential markets

IS THE accepted trend of growth of electrical energy at an end? Nobody believes this who is really familiar with the electrical situation, and yet how much *fact* is there to go on? What are the potential markets open to the electric power industry during the next decade? How will the magnitude and extent of these be affected by a change in the price of electric service? Would it not be of great benefit to the industry for it to

sponsor such a survey—not only a survey that will disclose the definite markets that can with reasonable assurance be reached under present conditions, but one that will show also the growth to be expected with a decrease in the cost of providing a kilowatt-hour?

Such a survey may show that the industry has definite and large markets available if it can decrease the cost of its service sufficiently. This has been found true in other industries, and to what extent it is true of the electrical industry ought to be definitely determined. That such a survey will be beneficial can hardly be doubted. It will tell us what's ahead; it will provide some sort of a bogey to shoot at; it will lend more definiteness to system planning, designing, construction and operation.

Definite responsibility for developing street lighting

IN TERRITORIES where a good street-lighting job has been done, some individual in the sales department has been charged with the exclusive responsibility of developing the business. Where a job not so good has been performed, it has been been evident that no one has had this responsibility. In the latter cases it apparently has been felt that no contacts should be made with municipal officials except through the district manager, operating superintendent or some other utility department head because of the "political" aspects. This state of affairs has in some places developed to such a point that no one in the new-business department takes any initiative in improving street lighting or selling additional energy for this purpose.

Therefore it seems that the first step to take in order actively and successfully to develop street lighting is to appoint some individual in the sales department who will assume complete responsibility for developing this class of business. He should have this work as his sole task, at least in large companies, and salary and promotion should depend upon the results he obtains in this field alone. When this is done the industry can look forward to much additional revenue from this source.

Co-ordination of insulation an urgent need

WITH the increasing use of high-voltage equipment and the better knowledge of lightning, it is well to check and if possible improve insulation specifications. The present wet and dry flashover tests have limited value and application for high-voltage equipment, and it is desirable to get a more rational allocation of insulation values for terminal equipment and line equipment so that they may be co-ordinated.

This principle is sound, but before new specifications are adopted it would be well to find out exactly what is wrong with those that exist. The first step is to state what is wanted, and then comes the task of finding out what may be done to make accurate tests in laboratories to meet new specifications. There is little use in a resort to elaborate tests and specifications if they do not give co-ordinated results.

For example, direct-stroke lightning waves are believed to have magnitudes ranging from one or two million volts up to perhaps fifteen million volts. The wave fronts and energy contents of these strokes are equally variable. Only the theory of probability can predict what may happen when lightning strikes electrical equipment as regards its energy, voltage and wave front. It is suggested, however, that if a very fast, a medium and a slow test wave front be used in laboratories for equipment tests, lightning conditions will be met in a fairly accurate manner. This reasoning is sound so far as it goes, but care must be taken to determine whether any laboratory and measuring devices can duplicate and measure accurately these lightning values. Overvoltage plus a large energy content must accompany the wave front, and the time elements involved are almost prohibitive as regards measurement. Before new specifications are adopted careful study should be made as to just what can be done.

A second factor in co-ordination of insulation has developed. Specialists agree that a line and a substation can be made immune even from direct strokes of lightning, at a price, by means of shielding conductors. If this be done, the voltage on terminal equipment will be limited to surge values which are of the order of little more than double line voltage, maximum magnitude. It may be

inadvisable, therefore, to increase insulation values or make high insulation specifications and tests on this equipment, thus adding costs, when money could be spent to better advantage on line and substation shielding.

It is a complex problem and requires much study. This study will be made. It is the part of wisdom to go slowly and accurately before standards are formulated.

Air pockets are found in depression abroad

THAT business abroad is dormant and sales effort futile is a popular excuse these days for sitting down and awaiting the end of the so-called depression. Like many fallacies, it has a germ of truth. Such a viewpoint, however, is not only unprofitable at the moment but a menace to future business.

Many areas in our foreign markets and many individual trades and industries are sorely depressed. But there is a rather remarkably wide diversity in economic conditions. Parts of Germany, for example, are in a bad way, but this has not prevented certain American truck manufacturers and certain washing-machine firms from doing a good business in that country. The Balkans, notorious for political ferment and uncertainty, now boast of several relatively prosperous areas. Jugoslavia and Bulgaria have widely diversified resources and their economic structures are evenly balanced. They are buying certain classes of foreign goods heavily.

These are but isolated examples. Certain areas and lines of business are prospering in many parts of the world. Several enterprising American firms have discovered this variation of conditions and are exploiting the opportunities offered. Our exports of electrical equipment, after all, have fallen only 11 per cent from an abnormally high year. They are still almost 21 per cent above 1928 figures.

Now is the time to canvass the foreign market for up-to-date detailed facts based on community analyses rather than to depend on broad and inaccurate generalizations. Others are getting business.

Deferring maintenance is hazardous policy

WHEN revenues from any class of business decrease there is a temptation to curtail expenses for maintenance so that net earnings will not be impaired. The objective is praiseworthy, but the method is not without perils. Adequate maintenance is fundamental to the continuance of the best service. Few elements are more influential in effecting a good operating record. Maintenance can be postponed for a relatively short time, provided the management starts from a high level of equipment condition, but if machinery and materials are calling urgently for repairs, deferment is risky in the extreme.

In personal matters it is easy to appreciate the hazards of putting off maintenance. In the preservation of health and keeping up of the home the cost of remedial measures increases like a rolling snowball if such matters are neglected. A parallel exists in the power system, but the structure is so complex and so extensive in area that the effects of postponed repairs are easily diffused and lost from sight. Remote and hidden weaknesses grow imperceptibly until suddenly a local fault occurs; service is interrupted or at least subnormalized, and in many cases the cost of restoration exceeds the expense of anticipating trouble. System design is a most vital factor in preventing the causes of interruptions, but the best system layouts known to engineering cannot function satisfactorily for any length of time without keeping maintenance activities reasonably in phase with the passing of time.

It is skating on pretty thin ice to defer maintenance in the hope that the prices of materials will go down sufficiently to justify putting off needed repairs. At present money spent on maintenance helps the national economic situation to a substantial degree, but no industry dependent upon high-grade plant performance needs any such reason for encouraging repair work. Operating conditions on properties which have always been well maintained reveal the wisdom of handling such work promptly and systematically at all times. A single day's visit is sufficient to prove the value of such a policy in comparison with that of trying to "get by" on an unreasonably restricted program.

Oil-Blast Breaker Theory Proved Experimentally

By

D. C. PRINCE

and

E. J. POITRAS

General Electric Company

Tests show correlation of recovery voltage rise and oil velocity. Performance independent of current and voltage

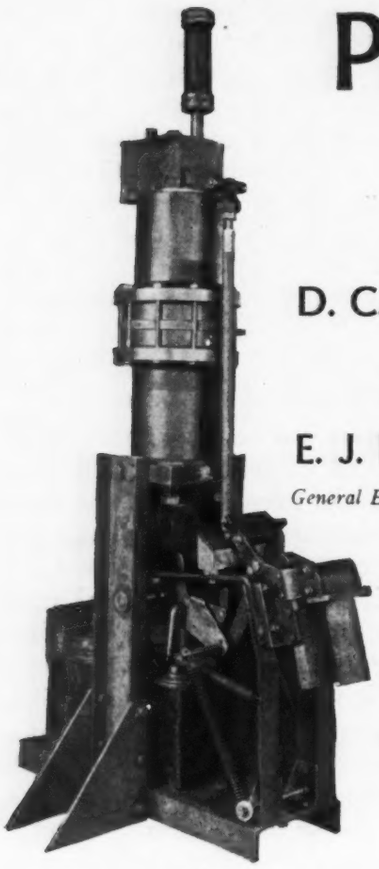


Fig. 1—Test circuit breaker

A CONSIDERABLE number of theories for the operation of oil circuit breakers have been advanced. Many of these have embodied conceptions which have been very useful in pointing out what construction changes would lead to improved performance, but at best the theories have been qualitative.

Although by following the theories it was possible to design satisfactory oil circuit breakers, they were not broad enough to indicate the performance of the breaker as regards arc length, arc duration and pressure on any specific test. The reason for this is that the theories involved multipliers which for design use were obtained from statistical data derived from many tests. Therefore, in order for such breakers to be safe and reliable when operating under varying conditions, it was necessary to base the design on maximum values.

A breaker operating on the principle of replacing the arc products by a blast of air[1] has been described in the European literature, and in the discussion of this breaker the velocity of the blast is related to the rate at which the system voltage recovers. Gas is a difficult medium to handle in a quantitative way, however, because its density, velocity and dielectric properties are subject to wide variations in accordance with temperature changes which are very difficult to observe or measure.

Oil is a much better dielectric than gas, so that any oil-blast circuit breaker is inherently more effective than a gas-blast breaker. From the point of view of analysis, it has the further advantage of employing a medium whose density and dielectric properties vary but little during operation.

An explosion chamber breaker has been so modified as to make use of an oil-blast. In a paper recently presented to the Institute[2] this breaker was described and the character of the phenomena involved was discussed. The number of variables in that type of circuit breaker is too high for easy analysis as a whole, but the problem can be broken down into its elements.

The rate at which voltage recovers across circuit-breaker terminals is dependent on circuit constants and nominal line voltage. This rate can be determined by measuring the inductances and capacitances and the rate of voltage rise then calculated with considerable precision. This has been done and the calculations checked by tests.

Correlation of recovery voltage and oil velocity

A circuit breaker is theoretically possible in which oil can be forced between the switch contacts at an observable and predetermined rate by a spring-driven piston. Using such a breaker, it is possible to compare the rate of rise of recovery voltage with the rate at which oil is forced between the contacts, and to note whether there is any correlation between the relative values of these rates and interruption of or failure to interrupt the circuit. An extended investigation has been made on such a breaker. Without dwelling upon the question as to whether a circuit breaker made in this way is commercially practicable, it is apparent that such an apparatus can be used to provide a definite quantitative check on the oil-blast theory. For the purpose of this paper, the most significant feature of such

[1] *Biermans, "Elektrotechnische Zeitschrift," Vol. L, 1929, page 1073. Wedmore, Whitney and Bruce, Journal of the Institution of Electrical Engineers (England), October, 1927, Vol. 65.*

[2] *Prince and Skeats, "The Oil-Blast Circuit Breaker," presented at the winter convention, A.I.E.E., January, 27, 1931.*

an arrangement is that the rate of oil flow can be measured and is not a function of current, as is the case when the pressure generated in a second arc is depended upon as a source of motive power.

Before proceeding to the data obtained, the various steps taken may be of interest. The breaker used and a section drawing are shown in accompanying illustrations. Briefly, the operation is as follows: When the trip impulse is received, the link (1) rotates in a clockwise direction about the pin (2), thus pulling the contact rod (3) into the open position and releasing the piston (4) at substantially the same time. The piston (4) is now driven upward by the spring (5), forcing oil inward and upward through the center of the hollow contact rod at the point where the arc is drawn (6). The separation of the contacts is limited to $1\frac{1}{4}$ in. in the open position. There were two reasons for the selection of such a low value of separation, both connected with reduction of the number of variables:

(a) It was desired to eliminate motion of the contact rod at the time of current zero.

(b) It was believed that a uniform flow of oil would be better maintained in a short gap than in a long one.

The manner in which interruption takes place is shown in Fig. 4. At the instant of current zero a cone-shaped boundary surface a—a may be assumed between the arc products and the oil. In a time dt this surface advances to a' — a', giving a minimum oil film thickness $d\phi$ over the contact tip to hold back the rising potential difference. The value of $d\phi/dt$ cannot be measured directly, but the rate at which the boundary surface as a whole advances is determined by the velocity of oil flow, which can be determined from the piston travel record. Whether or not the shape of the boundary surface is exactly as assumed is immaterial, as the difference in results is within the probable error of the whole procedure.

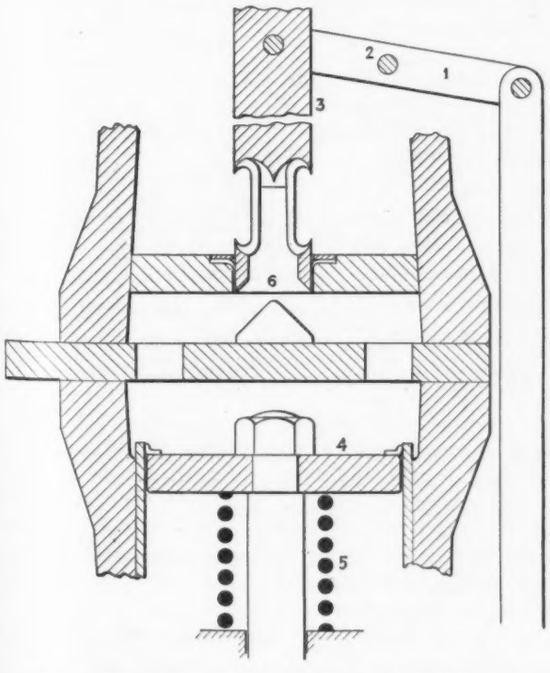


Fig. 2—Section of circuit breaker showing oil passages

(1) Link. (2) Pin. (3) Contact rod. (4) Piston, (5) Driving spring. (6) Arc space.

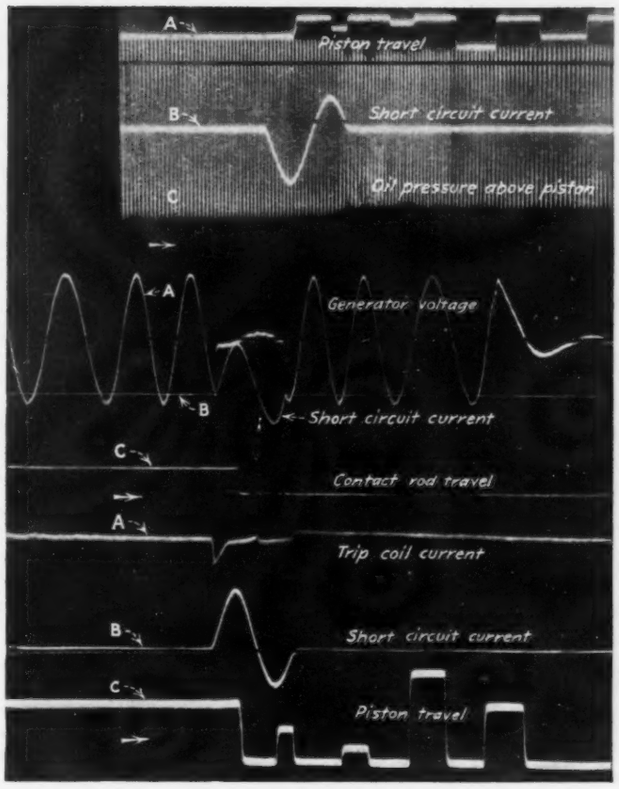


Fig. 3—Oscillograms of one OCO breaker operation

Top—(A) Piston travel. (B) Short-circuit current. (C) Oil pressure.
Center—(A) Voltage across breaker terminals. (B) Short-circuit current. (C) Position of contact rod.
Bottom—(A) Trip coil current. (B) Short-circuit current. (C) Piston travel.

Some 400 tests were made on this circuit breaker, with power supplied by a 25-cycle testing generator. The tests were made at three voltages, 13,200, 6,600 and 3,800, produced by changing generator connections, and at currents up to 23,000, 44,000 and 66,000 amp., respectively, at these voltages. Currents less than the maximum at each voltage were obtained by the use of variable series reactors in the lines.

In making the tests oscillographic records were kept of the current, voltage across the breaker terminals, trip coil current, oil pressure above the piston, opening of contacts and movement of the oil piston. A typical set of oscillograms is shown. The piston travel is recorded by a brush attached to the piston and passing over a series of segments connected to a source of potential through various resistances. The rate of oil flow is determined from the rate of piston movement at the first current zero following the opening of the contacts.

The inductances and capacitances of the various circuit elements were then measured by means of a high-frequency alternator. The testing generator and the circuits are shown schematically in accompanying illustrations as well as the connections of the high-frequency generator for making measurements.

From these data the recovery voltage characteristics for the different connections were calculated. These are shown in Fig. 8. Fig. 9 presents a summary of these calculations, giving the rate of voltage rise, taken as the tangent to the curve through the origin, at each tap and for each of the three generator connections. While these rates cover the range from 80 to 800 volts per microsecond, it is to be noted that the range covered by each of the generator connections is about the same. The tests should show, therefore, whether failures are to be attributed to current, voltage peaks, rate of rise or a combination of these elements.

Test results plotted

Taking the calculated values for recovery rate as ordinates and $d\phi/dt$ as abscissas, a large number of tests have been plotted in Figs. 10 and 11. In both of these figures successful tests are indicated by dots and failures are indicated by crosses. The dots and crosses are inclosed in circles, triangles or squares to designate the voltage at which the tests were made in Fig. 10 and the current in the arc in Fig. 11. A circle designates a test at 3,810 volts in Fig. 10, or less than 10,000 amp. in Fig. 11; a triangle denotes a test at 6,600 volts, or from 10,000 to 20,000 amp., and a square denotes a test at 10,000 or 13,200 volts, or more than 20,000 amp. It is to be noted that whether the breaker clears or fails is not correlated with the prevailing current or voltage, as is evidenced by the fact that dots and crosses are substantially evenly distributed among circles, triangles and squares. An attempt at correlation with the first peak of recovery voltage met with similar failure.

When a correlation with the relative values of recovery voltage rate and oil velocity is sought, however, the results are remarkable. A straight line has been drawn through the origin in Figs. 10 and 11, and it will be noted that practically all successful tests lie on the right of this line and practically all failures to the left; that is, within the precision limits of the measurements, this line divides the successes from the failures. The conclusion is obvious. If the recovery voltage rate is greater than a certain constant times the rate of oil flow, the breaker will fail to clear, but if, on the other hand, the rate of oil flow, multiplied by this constant, is greater than the recovery voltage rate, the circuit will be cleared. The value of the constant is determined by the slope of the line separating the failures and the successful tests and, if the theory is correct, should correspond to the dielectric strength of the oil. The value of dielectric strength indicated by the slope of the line in the present case is 550,000 volts per inch, a value not at all inconsistent with the strength which the oil would be expected to have under the prevailing conditions of rate of voltage rise.

The first points plotted were taken in a location where rates of rise above 500 volts per microsecond were not available, and no effort was made to investigate the lower part of the curve below 250 volts per microsecond. The consistency of performance in the region investigated, however, made it appear desirable to extend

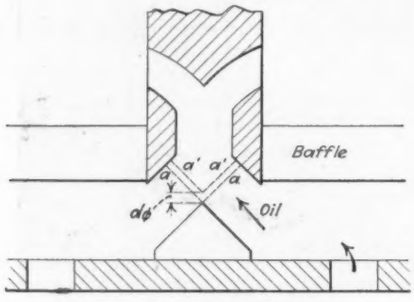


Fig. 4—Oil boundary at time of interruption

(*aa*) Position of oil cone at instant of current zero.
(*a a'*) Immediately after current zero.
(*dϕ*) Oil insulation introduced.

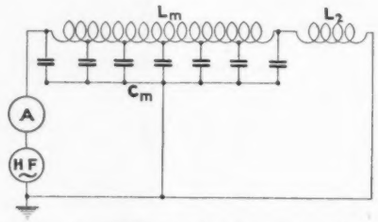
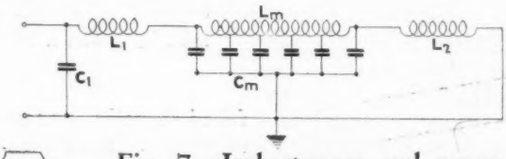


Fig. 6—Method of measuring circuit constants

(*Lm*) Inductance of short-circuit generator.
(*L2*) Inductance of ground side reactor.
(*Cm*) Distributed capacitance of short-circuit generator.
(*HF*) High-frequency alternator.



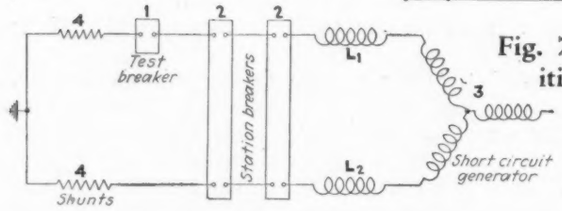


Fig. 5—Circuit breaker testing connections

(1) Test breaker. (2) Station breakers.
(L_1 and L_2) Current-limiting inductances.
(3) Generator winding. (4) Shunts.

Fig. 7—Inductances and capacities for determining rate of voltage rise

(*L1*) Inductance of high side reactor.
(*L2*) Inductance of low, or ground, side reactor.
(*Lm*) Inductance of short-circuit generator.
(*C1*) Capacitance to ground of each bus.
(*Cm*) Capacitance to ground of generator.

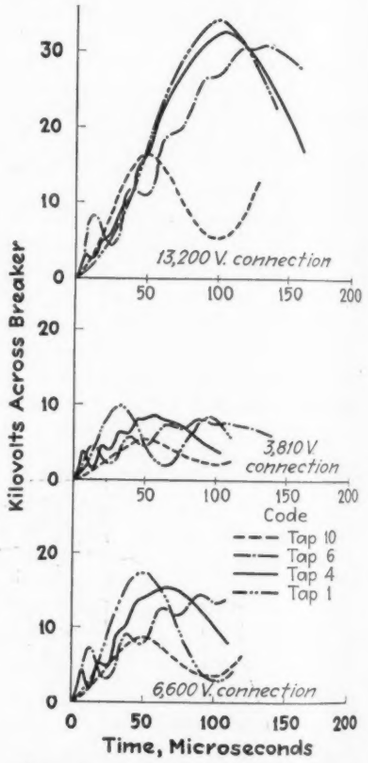


Fig. 8 — Recovery voltage curves for various test generator connections

the range of the investigation. Accordingly, in order to investigate the lower part of the curve, a special reactor connection was used, giving low recovery rates, and the breaker was throttled by placing a diaphragm in the path of the oil which limited the flow to that which would pass through a few $\frac{1}{8}$-in. holes. The higher recovery rates were investigated by means of a second device having a higher oil velocity.

As will be observed from an inspection of Figs. 10 and 11, the results were almost exactly as might have been predicted from the portion of the curve already known, the extension at the ends of the straight line already plotted dividing the new failures from the new successful tests within the precision limits of the measurements, just as the original portion of the line had divided the points from which it was plotted. In fact, those in charge of the later tests were able, regardless of voltage and over a wide range of current, to cause the breaker to fail or clear at will merely by changing

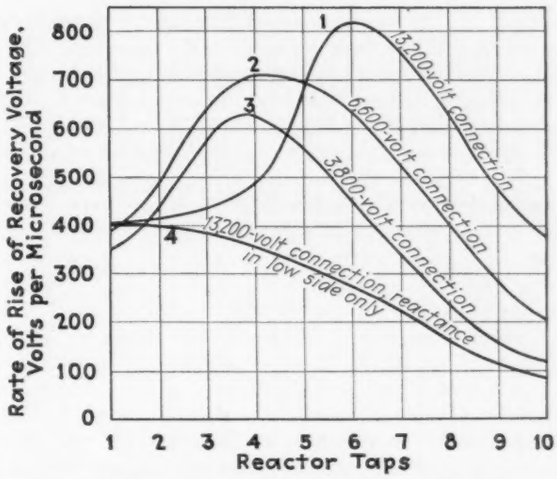


Fig. 9—Rates of voltage rise for various test generator connections

(1) 13,200-volt connection.
(2) 6,600-volt connection.
(3) 3,800-volt connection.
(4) 13,200-volt connection with current-limiting reactance in ground line only.

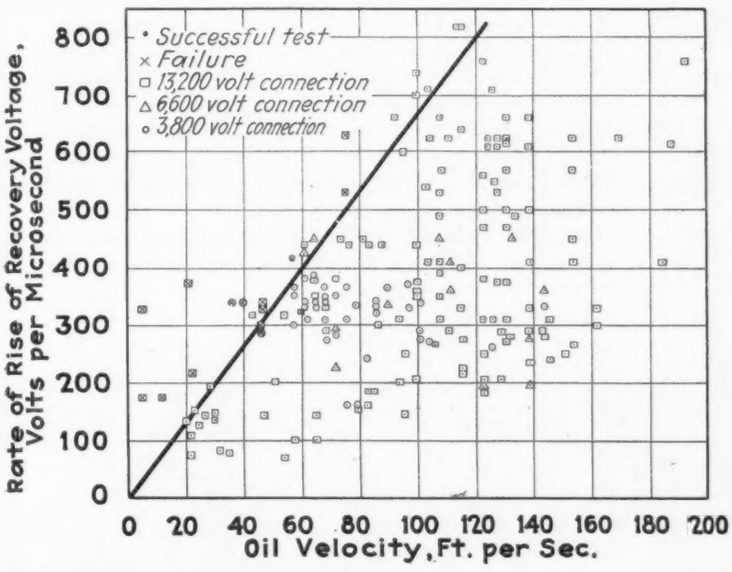


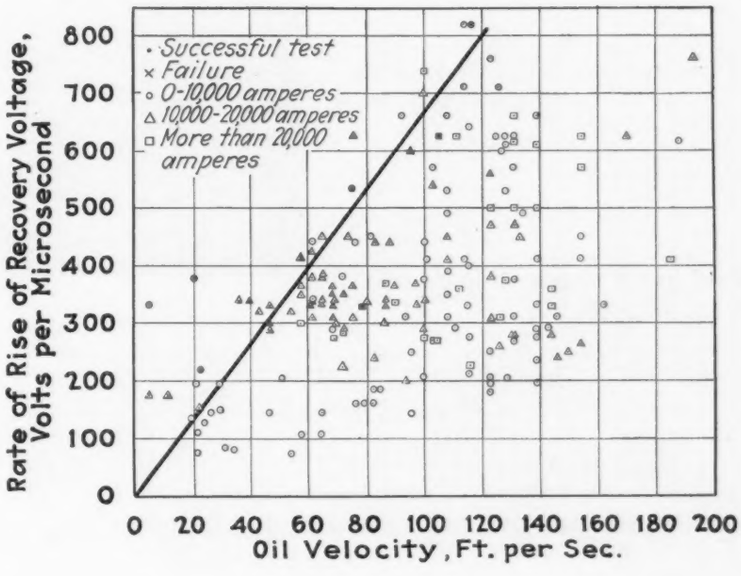
Fig. 10—Voltage not related to success or failure, but recovery voltage rate and oil velocity are correlated

the rate of rise of recovery voltage in the test circuit.

As has been previously stated, recovery rates up to 800 volts per microsecond have been investigated, which is about as high a rate as is to be expected at generator voltages. At transmission voltages, however, recovery rates as high as 3,000 volts per microsecond may sometimes occur. On high-voltage switches there is another factor tending to increase the severity of the situation in that the rise of recovery voltage is maintained for a longer period. This being the case, film thickness must increase at an even greater rate than is indicated by the difference in recovery voltage rates, for the time of application of high dielectric stress being longer, the effective strength of the oil is less. As a matter of fact, tests on a number of oil-blast designs indicate that while very good performance may be secured at voltages as high as 66 kv. per break, the arc duration is limited to one-half cycle only up to about 30 kv. per break. Higher voltages, however, may be reduced to the half-cycle basis by the use of multiple breaks with suitable means for distributing the voltage equally among the various breaks.

It may be a source of some surprise that such

Fig. 11—Current not related to success or failure, but recovery voltage rate and oil velocity are correlated



consistent results were obtained throughout the tests despite the fact that a long series of tests were run with no special effort directed toward maintaining the quality of the oil. This is, however, what might be expected from the present theory of the mechanism of oil breakdown, which states that breakdown occurs by the lining up of impurities until a chain is formed part of the way, at least, between electrodes. Obviously, if the time available for the formation of a chain is cut very short, the chain will not have an opportunity to form, and the impurities will have a relatively small effect. An investigation is at present under way to obtain data on this subject.

Whether the power which drives the oil blast is stored in a spring, as in the breaker used in this investigation, or supplied by a second arc, as in the oil-blast breaker previously described, or by some other scheme, will, of course, be determined by economic considerations. Whatever the source of motive power, however, the velocity of oil flow which must be produced has been established. This is the dominant element in the operation of the oil-blast breaker.

Oil has a known dielectric strength under operating conditions of $\frac{V}{l} = \frac{\text{Volts}}{\text{Inches}}$. A circuit provides a known rate of rise after interruption of $\frac{V}{t} = \frac{\text{Volts}}{\text{Seconds}}$. The circuit breaker must establish an oil film whose thickness increases at a rate $\frac{V}{t} \div \frac{V}{l} = \frac{l}{t} = \frac{\text{Inches}}{\text{Seconds}}$ which can easily be calculated. If the rate of increase of film thickness falls short, the breaker will fail, but if the film thickness increases at the specified rate, the circuit will surely be cleared.

Riderless Cars Operate on A.C. Over 6,000-Ft. Haul

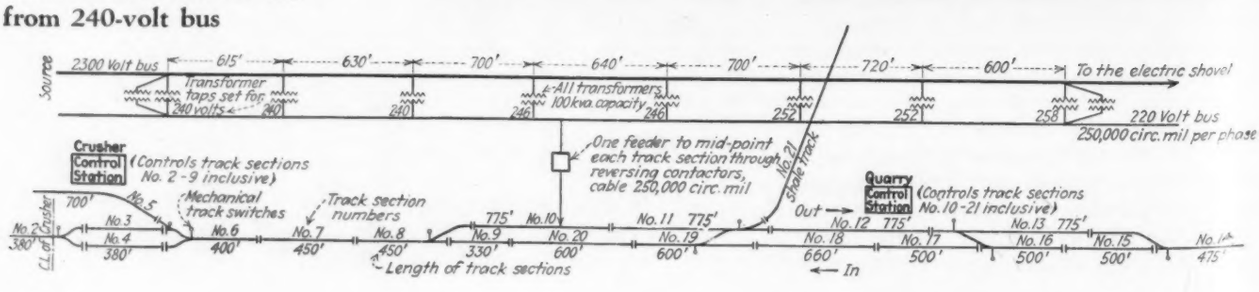
By R. F. EMERSON
Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

A transfer car system recently installed in the Dallas, Tex., plant of the Trinity Portland Cement Company combines the operating economies of alternating current, the reliability, sturdiness and simplicity of the squirrel-cage motor, the safety and reduced man-power that goes with centralized operating control and the further economies of regenerative operation.

There are four cars which run on a track approximately 6,000 ft. long and operated by three-phase, squirrel-cage motors geared to their axles. These cars travel back and forth between quarry and crusher house, their movements being entirely remotely controlled, for no operators ride on the cars. To accomplish this, the 6,000-ft. track was divided into twenty isolated sections, each of which can be energized or de-energized at the volition of an operator located at a control desk. In this system of transportation it is perfectly feasible to control the whole track system by one operator from one desk, but due to the length of the track in the present installation the control was allotted to two desks, near the quarry and at the crusher house, and a small panel at the shovel.

Operator at control desk moves cars on 6,000-ft. haul

Each track section is fed from 240-volt bus



As shown in the accompanying illustration, a 2,300-volt transmission line parallels the track taking power direct to the electric shovel. Step-down transformers deliver 220-volt power from this line to the twenty isolated track sections. This 220-volt power can be connected to or disconnected from the twenty track sections by means of twenty magnetic reversing switches mounted in weatherproof metal cabinets. The operation of the magnetic switches is controlled by the control switches on the operators' desks.

The electrical equipment on the cars themselves is limited to motors and brakes. One motor phase is grounded to the car frame. The two other leads go direct to the two collector shoes, which make contact with two-third rails. The usual method of operation is as follows: After a car is dumped and ready to be returned to the quarry the operator at the control desk throws the ten control switches in the proper direction, causing the brakes to release and the car to start and proceed to section No. 8. If the track is clear all the way to the shovel the operator at the quarry control station passes the car on to the shovel man, who can either bring the car up to the shovel and spot it for loading or he can hold it on a dead track section until he is ready for it.

When a car is loaded the shovel operator sends it in, on the return track. The quarry control station operator passes it on to section No. 9, which is under control of the operator at the crusher control station. This operator can either bring the car immediately up to the crusher or he can hold it on section No. 9 until the outgoing empty has cleared sections 6, 7 and 8.

The small control switches on the control desks are of the three-position type and labeled "in-out-stop." Indicating lamps are also provided indicating the direction of travel of the cars. Reversal of operation is obtained by selecting the proper reversing contactor and obtaining phase reversal at the motor terminals.

The motors have been especially designed for the service. Since they start the cars by being thrown on full voltage, their starting torque was kept low enough to avoid any tendency to cause the wheels of an empty car to spin, but yet have sufficient torque to accelerate a loaded car to full speed in a reasonable time.

The installation has some grades, but there is no chance of a runaway when a car goes down grade, because an induction motor automatically regenerates current when it is overhauled and thus acts as a brake to the car. This characteristic of the induction motor avoids the complication of resistor grids, contactors or relays necessary for dynamic braking with d.c. series motors.

Experience with Pin Type Insulators*

By F. E. ANDREWS

Public Service Company of Northern Illinois, Chicago, Ill.

Line insulator failures caused 1.8 per cent of the total line interruptions in 1929 and 2.8 per cent during 1930 on the system of the Public Service Company of Northern Illinois. By insulator failure is meant those cases where breakdown takes place through the insulator because of cracks or punctures through the porcelain. In other words, because of some defect inherent in the insulator itself. Interruptions due to insulator failure are generally more serious than those from other causes, since they usually mean more damage to the lines, such as burning off of a crossarm or pole, or the burning off of a conductor due to the arc.

Many of the insulators purchased during former years have developed shell cracks. A large number of these insulators are still in service on the lines of the Public Service Company of Northern Illinois in spite of an insulator test program that has been under way for a number of years. It is the opinion that line trouble does not develop from these insulators unless cracks occur in more than one shell. It is also the opinion that there is very little difference in the lightning performance of these older insulators as compared with those of later types, except that when a lightning flashover occurs the former are more liable to be shattered, allowing the line conductor to drop on the crossarm, or allowing leakage from normal voltage to start a crossarm fire.

Considerable study has been devoted to the problem of insulator damage from external causes, such as from stone throwing and gunshot. As a result of this study the Public Service Company of Northern Illinois adopted one-piece thick porcelain insulators early in 1929. It is apparent from the record shown in the tables that multi-part insulators of the conventional design are much more susceptible to damage from external causes than one-piece thick porcelain insulators and that a considerable reduction in operating expenses can be effected by the use of the latter. Trial installations were made of the one-piece thick porcelain insulators in the vicinity of schoolhouses, where their qualities would be tested best. These installations have demonstrated conclusively that the one-piece insulator is much less susceptible to breakage.

**Abstracted from paper presented at fall meeting, 1930, of Engineering Section, Great Lakes Division, N.E.L.A.*

How Conductor or Structure Failures Are Influenced by Insulator Cracking

(January 1, 1929, to November 1, 1930)

	With Insulators Free from Cracking	With Insulators Subject to Cracking
Conductor burned down due to lightning flashover	40	33
Conductor burned down due to insulator failure (not lightning)	0	38
Total	40	71
Structure burned due to insulator failure (not lightning)	1*	24

*Due to factory test puncture.

Pin-Type Insulator Performance

The fewer number of flashovers shown for the one-piece insulators is due primarily to the fact that most of these insulators are installed on new lines which are of all wood construction and are not subject to power system flashovers.

	Insulators			
	One-Piece		Multiple-Piece	
	1929	1930*	1929	1930*
Insulators in service	3,000	8,000	130,000	126,000
Damaged by rocks and gunshot per 1,000 in service	1.3	1.4	10.5	8.9
Damaged by electrical flashover per 1,000 in service	0.33	0.9	4.2	4.3
Insulator failures	0	1†	23	32

*First nine months of year. †Due to factory test puncture.

Complete Industrial Power and Heat Service*

By JOHN M. DRABELLE

Mechanical and Electrical Engineer
Iowa Railway & Light Corporation, Cedar Rapids

PUBLIC utility power stations have their location fixed generally by transportation facilities for fuel and an adequate supply of condensing water. This usually fixes their location, in the so-called industrial districts of cities and towns, and with a little further study such a location could be tied up with the possibility of supplying to adjacent manufacturers a complete service—electric power and steam for heating and process purposes. In this manner a higher load factor can be secured for the boiler plant and for the power generation equipment, with certain modifications such as bleeder and back-pressure turbines to handle this load.

When industrial plants were small it was difficult for them to secure adequate financing for the development of their power supply and competent engineering help for the designed construction, maintenance and operation of such undertakings. The technical schools of this country have furnished a large percentage of their graduates in the past to the central-station industry, but, due to the extensive consolidation of public utilities that has taken place in the last few years, the supply of such technical graduates has been greatly in excess of the utility demand, and there have been released also a large number of experienced, competent, well-trained men, thoroughly versed in large power station operation, who can build and operate successfully large power stations for industrial plants.

With the steady rise of boiler pressures from the 100-125 lb. that yesterday was considered by power engineers as good industrial practice, today the large industrial plants have at their command pressures ranging from 450-1,200 lb. gage with accompanying high superheat, and a consequently high kilowatt-hour recovery from steam turbines of the "reducing valve" type.

Demand is for complete service

To the smaller manufacturer is offered multiplicity of prime movers ranging from small back-pressure turbines to oil engines. For the hotel, the office building and similar situations are offered various combinations of moderate high-pressure boilers (250 lb.) with heat-balance schemes combining various types of reciprocating steam engines, steam turbines and a recent combination of oil engines. This is the situation confronting the public utilities today. The question is, what are they going to do about it? The day of the public utility plant offering but a single service, namely, electric light and power, to industries, office buildings, hotels, and similar situations, is rapidly becoming past history, due to the demand on the utilities for a complete service.

The utility must therefore be ready to supply three commodities, steam for heating purposes, electric light, and power. This service must be furnished at a rate which is stripped of everything except cost plus a profit. As the electric motor of the '90s gave to small industrial plants ample power at a cost comparable with those plants which were large enough to manufacture at the then accepted costs, so today will this dual service to industrial plants make possible the creation of industries of small size, which to date have been unable to compete on account of cost of service, made expensive because of the lack of balance between the use of power and steam. For the larger manufacturer the utility must be prepared to furnish not only large quantities of electrical power, but also steam at varying pressures and temperatures, according to the peculiar demands of that particular manufacturer. A fourth group includes the very large manufacturer who uses large quantities of process steam, the demand of which does not coincide with the demand for electric power, but is co-ordinated with his power plant for heat-balance purposes.

Stated briefly, when the manufacturing plant's electric demand is low, but with process steam demand high, then by loading up the prime movers in the manufactur-

Public utility management should give due consideration to the combined steam and electric plant with dual service. The availability of such a service forms a large factor in the economic set-up of an industrial plant, and if omitted by the utility in its analysis, imposes a very severe penalty upon the latter's economic set-up.

There is a tendency on the part of many power companies to ignore the capacity factor of this by-product power equipment merely because it is

*Based on paper presented at Midwest Power Conference, Chicago, February 10-13.

ing plant electric energy can be delivered into the lines of the utility company. When the reverse condition is true, with electric demand high, but with process steam demand low, then the lines of the utility company can deliver to the manufacturer the necessary additional increment of electric power required, represented by the difference between the total demand for electric power and the electric output of his prime movers, which are then supplying only the required demands of process steam. Such a scheme of heat-balance operation means that at times of high electric demand and low process demand steam is not wasted over the roof.

Many examples already available

The Deepwater station of the Deepwater Light & Power Company, which is a combination power plant of the United Gas Improvement Company and the Atlantic City Electric Company, combined with an electrical and steam supply service to E. I. du Pont de Nemours & Company. The Du Pont equipment in this station, for the purpose of this paper, is particularly of interest:

A single-cylinder, non-bleeding, non-condensing, 1,200-lb., 725-deg. F. total turbine, rated 12,500 kw., 0.8 power factor, has been installed. This exhausts at 200-400 lb. into seven evaporating units of 4,430 sq.ft. each. These evaporators will generate 400,000 lb. of vapor per hour at 180 lb. gage pressure and superheating the vapor to 440 deg. F. total when receiving 530,000 lb. per hour of exhaust steam from the 1,200-lb. turbine. This is a typical case of combination supply and a complete service to the large power consumer.

Another interesting installation is that of the Southeastern Production Company at Mobile, Ala., a power plant designed and built to furnish both power and steam to a new paper mill of the International Power Company. This station will supply a total steam requirement of 135,000 lb. per hour, divided as follows: 85,000 lb. per hour at 150-lb. gage pressure and 100 deg. superheat and 50,000 lb. at approximately 35 lb. gage pressure and 2 per cent moisture. The production company, under its contract, agreed to install electric generating facilities having a rated capacity of 7,500 kw. to furnish power to the mill. The production company station is tied in with the lines of the Alabama Power Company for interchange of facilities and for the maintenance of heat balance. The production company has the right to deliver any or all of the electrical energy from or to the Alabama Power System. Some of the details:

Make-up water will run as high as 60 per cent; relatively low boiler ratings were decided upon and three Stirling 1,311-hp., XXV-type, fired by underfeed stokers, were installed; steam pressure 475 lb. and a total temperature 650 deg. F.

The prime movers are one 6,000-kw. back-pressure, double-extraction type, eight-stage turbine, equipped with two-arm mechanism for back pressure and extraction control. Extraction openings are provided in the turbine shell after the first and sixth stage, at which the steam pressure is held practically constant at the pressures of 150 lb. and 35 lb. gage, respectively. The maximum rate of steam extraction at the 150-lb. point is 100,000 lb. per hour and at the 35-lb. point is 70,000 lb. per hour. The exhaust section of the turbine is designed to pass 20,000 lb. per hour. Exhaust pressure is regulated automatically to any value between 0.5 lb. gage. A 2,000-kw. condensing unit is also installed in the power plant.

not large enough to displace a 50,000-kw. or larger capacity turbine. These bleeder non-condensing turbines, operating between 225 lb. and 425 lb. gage, with the commercial superheats available today, will generate a kilowatt-hour at approximately 4,000 B.t.u. per kilowatt-hour and have by-product steam available for other purposes which will permit the utilities to be competitive in the industrial power field, to meet the competition of the isolated plant and the oil engine salesman and to supply to the small users a complete service.

Power and steam for oil refinery

Another interesting installation is that of the Louisiana station of the Louisiana Steam Products, Inc., near Baton Rouge. This station has and will supply to the Standard Oil Company approximately 840,000 lb. per hour of steam of 135 lb. pressure gage and 438 deg. total temperature and electrical power up to approximately 16,000 kw. maximum to the refinery. Steam will be generated at 640 lb. gage pressure, 750 deg. total temperature in the boiler plant; this steam will pass through two or more of three 15,000-kw. steam turbines, which will exhaust at the pressure and temperature of delivery to the refinery. Electric power generated in excess of that required by the refinery will be supplied to the Baton Rouge Electric Company or to the transmission system of the Gulf States Utilities Company:

The exceptionally high load factor of this plant (about 80 per cent estimated) justifies certain refinements, such as the use of both economizers and air preheaters in the boiler units. On the other hand, the fact that this is primarily an industrial plant has not warranted the expenditure for building structure that is usually considered desirable for a public service plant of this size, and efforts are being made to obtain extreme simplicity in building and equipment, without sacrificing economy or electric generating capacity.

The main turbines will be simple, high-pressure, non-condensing machines. Low-pressure steam for three-stage feedwater heating will be obtained from the various steam-turbine-driven auxiliaries; the boiler feed pump turbines are to exhaust at about 5 lb. absolute to the low-pressure heater, and the fan turbines are to exhaust at about 5 lb. gage pressure to the deäerators. Steam for all auxiliaries and the high-pressure water is to be taken directly from the main turbine exhaust lines. All other plant auxiliaries, except one fuel oil pump, will be motor driven.

An unusually complete water purifying plant, which will consist mainly of settling, clarifying, filtering, treating and softening equipment, with capacity of 2,000-gal.-per-minute treated Mississippi River water, is being provided to supply the large amount of boiler feed make-up required.

The boiler plant is unique in that the fuel will be approximately 50 per cent natural gas, 33 per cent liquid refinery waste and 17 per cent petroleum coke. The petroleum coke will be burned in pulverized form.

Utility-owned plant for industrial steam alone

An interesting combination station is that of the Western Electric Company at Point Breeze, Md., operating in combination with the Consolidated Gas, Electric Light & Power Company of Baltimore, Md. This station does not generate any electrical power owing to the extremely varying steam demands, but is operated by the utility company, under a five-year contract, for the

Western Electric Company, the utility company undertaking to furnish both steam and electrical energy without, at the present time, any production of by-product power.

Particulars	Initial	Ultimate
Power for process demand, kw	13,000	28,000
Power house auxiliary and lighting, kw	1,000	3,300
Process steam (100 lb.), lb. per hour	44,000	71,000
Process steam (200 lb.), lb. per hour	11,000	21,000
Heating (15 lb.) annual consumption (1,000 lb.)	123,000	400,000

The Rochester Gas & Electric Corporation of Rochester, N. Y., has constructed adjacent to the business district a modern high-pressure, high-temperature generating station, employing pulverized coal for the firing of the boilers, with steam turbines extracting steam at approximately 125 lb. pressure for the high-pressure system, and for the low-pressure heating system expansion through the turbine to 15 lb. gage.

To meet the requirements in the manufacturing district of Rochester two stations have been constructed for that service supplying both steam and electrical power. The system in Rochester involves a total of 11,750 kw. of installed capacity of non-condensing turbines, some straight non-condensing and some of the non-condensing bleeder type. Approximately 10,000 kw. of capacity is delivered by these dual-purpose stations during the months of November, December, January and half of February, which is approximately 13 per cent of the total system load, and these by-product power plants reduced the capacity required in their main condensing steam station by that amount.

Power Generation, Steam Demands and Service Bills

	1928	1929
Low-pressure steam (thousand lb.)	65,441.7	70,566.7
High-pressure steam (thousand lb.)	79,643.1	80,299.5
	145,084.8	150,866.2
	Kilowatts	Kilowatts
Direct-current peak demand	400	400
Alternating-current peak demand	1,304	1,304
Kilowatt-hours, direct current	809,600	903,900
Kilowatt-hours, alternating current	3,147,600	3,484,800
Total steam bill	$74,560.17	$75,382.78
Total electric bill	68,445.71	75,672.32
Combined total bill	143,005.88	151,955.10

Steam and Electric Revenue

	1928	1929
Steam income	$72,616.89	$74,368.39
Electric income	82,715.47	115,913.52
Combined total	$155,332.36	$190,281.91

Power and steam to cereal plant

Since 1914 the Iowa Railway & Light Corporation has furnished all of the steam and electric power to the mill of the Quaker Oats Company ot Cedar Rapids, Iowa. This load has grown from approximately a steam load maximum of 20,000 lb. per hour and 1,400 kw. of demand in 1914 until today the maximum steam demand of the Quaker Oats Company is approximately 70,000 lb. per hour, with an electric maximum demand of approximately 7,500 kw. The Iowa Railway & Light Corporation has also been engaged for many years in the central heating business in Cedar Rapids, both high- and low-pressure steam service being furnished to hotels, office buildings and hospitals. The following quantities are of interest:

Approximate Demands

Service	Pounds per Hour
Low-pressure heating system	90,000
High-pressure heating system	30,000
Steam to Quaker Oats Company	70,000

This gives approximately a total maximum demand of 190,000 lb. per hour, with a simultaneous coincident demand of 170,000 lb. per hour.

Approximate Annual Steam Consumption

	Pounds
Low-pressure heating system	180,000,000
High-pressure heating system	65,000,000
Quaker Oats Company	170,000,000

The Quaker Oats Company is furnished both steam and electric service under a cost-plus form of contract, the Quaker Oats Company paying the interest and carrying charges on all of the exclusively used equipment, such as the steam main between Sixth Street station and the Quaker Oats mill, the electric cable supplying the mill and the substation located at the mill. For jointly used equipment, such as the power station, this is allocated on the basis of maximum demand. Further details:

In order to secure energy recovery from the live steam at 225 lb. gage and 100 deg. superheat a byproduct turbine of the "reducing valve" type has been installed and recently placed in service. This is a 7,500-kw. non-condensing turbine taking its steam from the main header of the station at 225 lb. gage and 100 deg. of superheat. The turbine, by means of a stage valve, extracts steam at 100 lb. gage from the first stage for the heating of feedwater and for high-pressure steam service. Steam passes through the other four stages of the turbine to the low-pressure heating system at varying pressures of from 5 to 25 lb. gage, depending on the steam demands and pressure requirements of the city. The turbine is capable of passing a maximum throttle flow of 250,000 lb. of steam per hour, with steam extraction up to 90,000 lb. per hour at the first stage, and a flow to the low-pressure heating system of 160,000 lb. per hour. It is expected that this turbine will deliver to the station bus approximately 12,000,000 kw.-hr. per year and add a potential capacity under winter conditions of 7,500 kw.

In considering such equipment for by-product power purposes it must be borne in mind that such a unit requires no other equipment than the unit itself, no condenser, no circulating water and other associated auxiliaries that go with a condensing turbine. Such an installation has been actually made for about $25 to $40 per kilowatt. The B.t.u. rate of the machine is approximately less than 4,000 per kilowatt-hour, energy recovered alone being considered, and the steam passed through the machine is available for central-station heating service and feedwater heating.

It is expected that a second unit will be added later, when the Quaker Oats Company makes certain piping changes in the mill which will permit it to use a lower steam pressure. Based on the present consumption of steam at the mill and a pressure of 100 lb. gage, this source alone would amount to approximately 1,500,000 kw.-hr., assuming a steam rate at the high stage of the machine of approximately 100 lb. per kilowatt-hour.

The turbine is equipped with a special governor mechanism so as to maintain constant first-stage extraction pressure and constant pressure at the exhaust to the low-pressure heating system. The pressure at the exhaust is adjustable. The governor of the machine will automatically load up the turbine to meet the requirements of the high-pressure flow and, secondly, the low-pressure exhaust flow.

Photoelectric Control for Soaking-Pit Covers

By R. M. BAYLE
Steel Mill Engineer
Westinghouse Electric & Manufacturing Company

Steel is made by refining the molten iron from blast furnaces. Still in the molten state, it is cast into rectangular blocks, known as ingots, usually weighing from 4 to 25 tons. After being allowed to solidify the molds are stripped off and the ingots are now ready to be heated to a rolling temperature for reduction to commercial shapes.

The furnaces used for this purpose are vertical square pits, heated by gas and called soaking pits. A crane with a specially designed tong is used to charge and withdraw the ingots. To avoid excessive heat losses these pits must be closed during the heating cycle. A sliding door lined with firebrick is used and in modern mills is operated by an electric motor.

Some years ago it was found that the man-power required in the soaking pit building could be reduced by having the soaking pit crane operator open his own pit covers instead of depending on another operator located on the floor. Not only did this reduce the number of men required for this operation but it removed the delays incidental to synchronizing the operation of two men performing consecutive operations. The first systems used control circuits carried from the moving crane to the stationary motor control by additional crane rails.

For a new mill in the Middle West the Westinghouse Electric & Manufacturing Company is supplying a new design of soaking pit control, making use of a light sensitive relay as the initiating source. The moving crane carries only a foot-operated push button and a light box mounted on the end of the crane for each soaking pit spanned by the crane. In this installation the layout consists of two soaking-pit cranes operating on a common runway and each spanning two pits. There are seven rows, making a total of fourteen pits.

In operation the crane operator runs his crane over the pit cover he wishes to open. The operating-light box is long enough to allow for a considerable zone of operation. Preparatory to opening a cover or during the operation the crane may be shifted 5 ft. on either side of the center line and the operating lamp box will still be opposite the light relay for that cover.

To open the cover a single short flash of the lamps in the light box is all that is necessary. As light falls on the light-sensitive tube in the light relay it passes current which energizes a relay that starts the pit cover motor in the open direction. The circuit is self-maintaining; the motor continues to run until the cover is wide open, when stopped automatically by a limit switch.

When the crane has removed the ingot the operator again flashes high light and the circuit is now such that the motor is energized by the light relay to close the cover. An ingenious but simple transfer circuit permits the light relay to be alternately effective to open or close the pit cover. Thus the light circuit is not depended upon to hold the cover open and there is no danger that the burnout of a lamp would close the cover on the tongs of the crane. Supplementary master switches are provided on the floor for the use of the furnace attendants. These are only used occasionally to inspect a heat. Interlocking is used which gives the crane operator supreme command. Should a floor operator attempt to close a cover from which the crane was withdrawing an ingot, the crane operator could immediately cancel the cover movement.

This form of control is simple in so far as circuits and equipment are concerned and is a decided improvement over the older types requiring additional crane rails. For transferring a control circuit from a moving source to a stationary point a light beam provides the simplest connection. The light-sensitive cells used respond only to concentrated light above the room illumination, so there is no danger of false operation.

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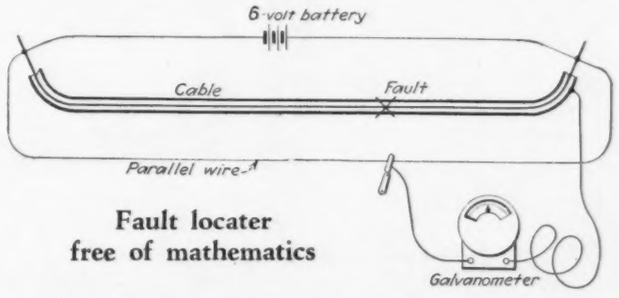
Finding Cable Sheath Faults

By JOHN ERICKSON
St. Joseph, Mich.

An extremely simple method, that makes use of only a 6-volt battery, a galvanometer and a length of wire, has been found to be unusually accurate in locating conductor-to-sheath faults in lead-covered parkway cable on series street lighting systems. It may also be used on multi-conductor cables. As is apparent from the drawing, the method is a bridge test, but it involves no numerical determination of resistances nor any calculation of relative distances.

The fault has been located between two lamp risers, let us say. The problem now is to find the exact place. The faulty cable section is disconnected at both ends, and the course of the cable as shown by the system map is paralleled with an insulated wire laid on the ground. The ends of this wire are connected to the cable conductor ends, as are also the battery terminals. One post



Fault locater free of mathematics

of the galvanometer is connected to an end of the cable sheath with a wire long enough so that the instrument may be carried to the other end of the cable section if that is necessary. The other galvanometer post carries an exploring lead that terminates in a knife blade or a sharp point by means of which contacts may be made through the insulation of the wire that parallels the cable run. It is important that all contacts in the bridge shall be well made, that the parallel wire shall be of one piece, or at least of one size only, and that any end loops of the parallel wire shall be equal in length so that the circuit is symmetrical. The point of zero reading on the galvanometer indicates the place to dig for the fault.

New Substation Design Sa

By R. B. POLLOCK

Department of Engineering Design,
Southern California Edison Company, Ltd.,
Los Angeles, Calif.

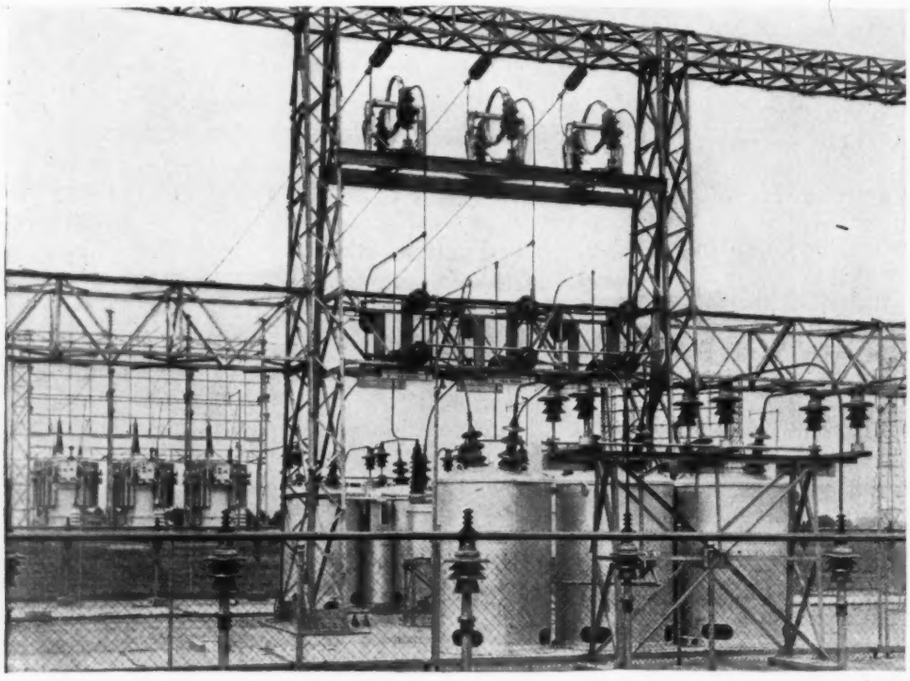
Pedestal type 66-kv. bus and "A"-frame dead-end structure are new features at La Fresa. Omission of lightning arresters and instrument transformers on feeder circuits effected further savings

INCORPORATED in the design of La Fresa substation, the seventh 220- to 66-kv. station to be built by the Southern California Edison Company, Ltd., are to be found several important new developments resulting from experience gained at former stations. Perhaps the most interesting of these is the pedestal type 66-kv. bus and switchrack shown in the accompanying illustrations.

While there has been a saving of about $900 per circuit at La Fresa due to the installation of the new type of rack instead of its equivalent of the preceding type, the greatest saving is in the omission of the lightning arresters and instrument transformers. This amounts to about $7,100 per circuit. The total saving on the 30 circuits, for which provision has been made, will be between $225,000 and $250,000.

The general design of this rack conforms closely to that which has been used at 220-kv. substations for a number of years and now used by some of the Eastern companies. Its application to the 66-kv. circuits has been made possible largely by omission of lightning arresters from the feeders and development of the air-insulated current transformer, which is better adapted to this type of structure. The use of gang-operated, remote-controlled disconnecting switches also has aided greatly in simplifying the design.

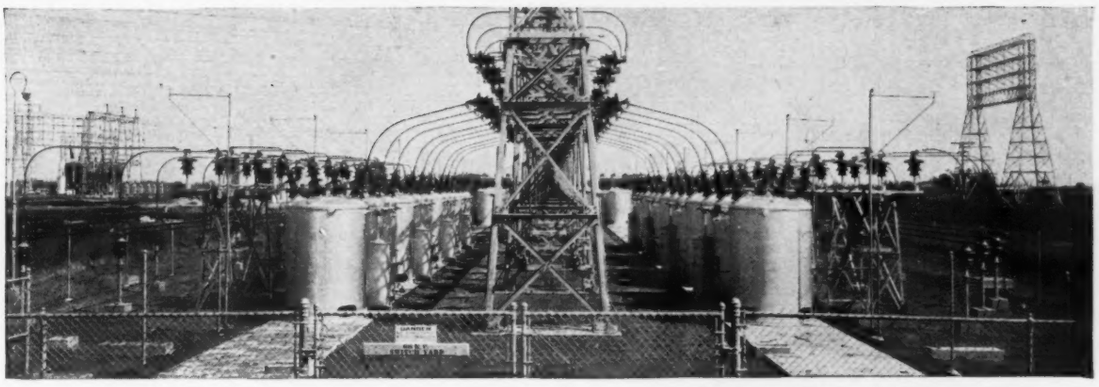
Throughout the design of La Fresa substation a careful study of the requirements has resulted in the simplification of circuits and the elimination of all except essential apparatus. Previously it was customary to provide individual wound primary type current transformers and individual potential transformers on the 66-kv. feeders for metering, relaying and synchronizing, but at La Fresa it was found that the burden due to the indicating ammeters and wattmeters, when placed in series with the relays on the bushing type current transformers, was so small that the action of the relays was not affected. Wound primary type current transformers were therefore omitted from the feeders and provided only on the main transformer circuits, where greater metering accuracy was desired. Synchronizing of feeders was not considered necessary except after being taken out of service for changes or repairs, in which case the feeder to be synchronized is connected to a clear section of one bus and synchronizing is accomplished between buses. Potential for the feeder wattmeters and directional power relays was obtained from potential transformers provided on the main transformer circuits only, thus



Transformer position on 66-kv. rack

Showing mounting of current and potential transformers, disconnecting switches and oil circuit breakers.

Saves Quarter of a Million

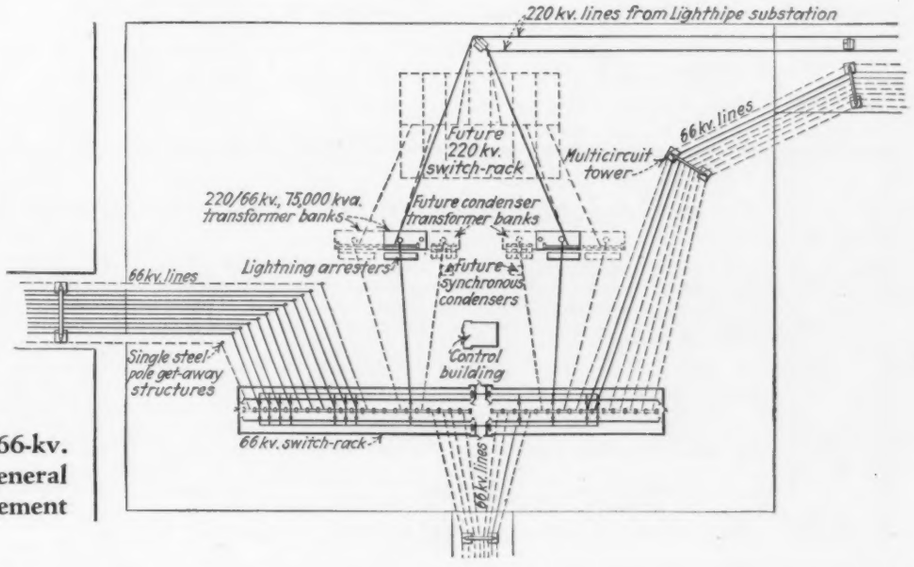


66-kv. switchrack and pedestal bus that saved $900 per circuit

no potential transformers were required on the feeders. Lightning arresters on the individual feeders have previously been considered necessary to protect the instrument transformers. With the elimination of these transformers there does not seem to be sufficient reason for continuing this practice; however, the power transformers were protected by providing lightning arresters on their low-tension leads. This seemed to be the proper place for the arresters, since it is at this point where the lightning surges are reflected and the highest voltages are developed. Thus only two arresters were required on the two present 75,000-kva., 220-66 kv. transformer banks. A maximum of six ultimately will be required when all banks are installed. If the arresters had been placed on the feeders, ten already would have been used and eighteen more required ultimately. This represents a considerable saving without sacrificing protection on any apparatus which would be costly to repair.

With elimination of the arresters from the feeders and the use of air-insulated current transformers and gang-operated, remote-controlled disconnecting switches, the design of the pedestal bus type of rack became a simple problem. As will be seen in one of the drawings, the conventional double bus is used with two oil circuit breakers and four disconnecting switches per circuit. The two line disconnecting switches were mounted vertically on the center dead-end structure and the oil circuit breakers were placed on concrete pads on each side of this structure and the buses located beyond the breakers. The bus disconnecting switches were mounted horizontally on small steel racks between the breakers and the buses and the buses were supported from the ground on short pieces of 3-in. pipe with an insulator on top, as illustrated, hence the name "pedestal bus." Each bus, with its associated disconnecting switches, is completely inclosed by a fence, the gates to which are kept locked when the buses are hot. The area in the center of the rack, inclosed between the bus fences, forms a common operating aisle for both buses in which are located the operating handles for all disconnecting switches.

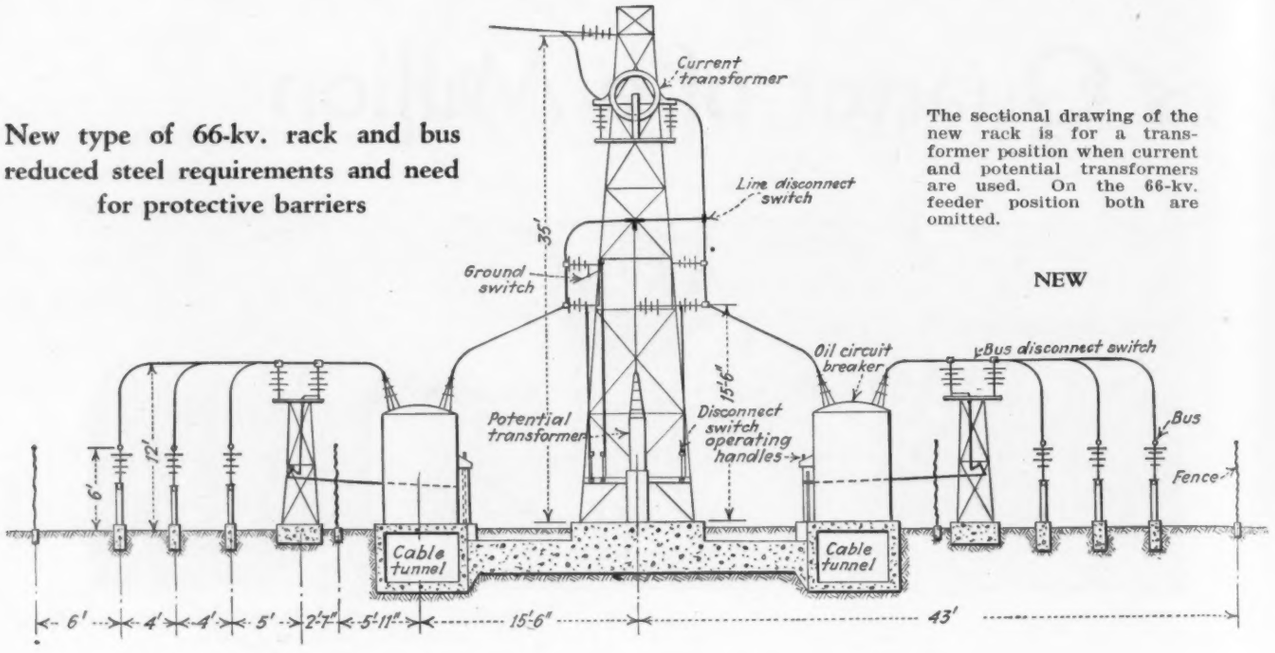
The air-insulated current transformers, used only on

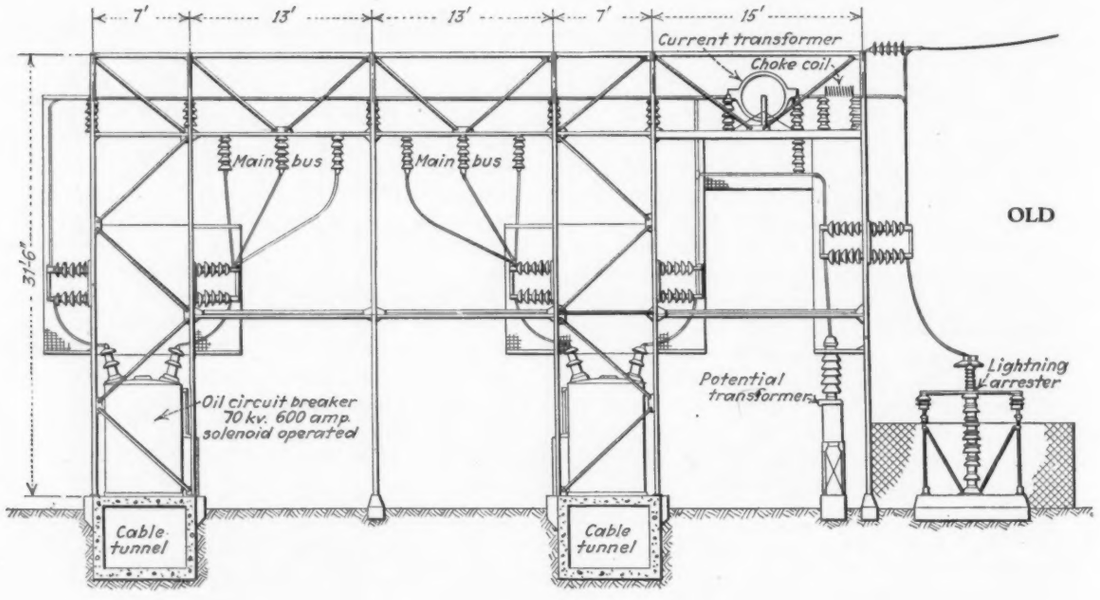


Plan of La Fresa 220/66-kv. substation showing general arrangement

New type of 66-kv. rack and bus reduced steel requirements and need for protective barriers

The sectional drawing of the new rack is for a transformer position when current and potential transformers are used. On the 66-kv. feeder position both are omitted.





Advantages of the La Fresa Switchrack Design

1. A better general appearance has been obtained, due to its simplicity, greater symmetry, and better proportions.

2. It has greater operating convenience because of the common operating aisle, in which all operating handles are located.

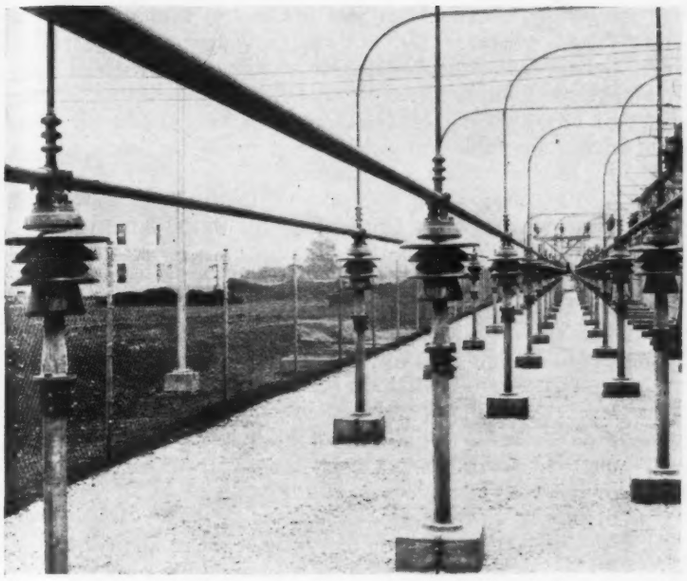
3. Greater reliability has been obtained by the use of fewer insulating supports.

4. Fewer switching mistakes should be made because of the greater simplicity and symmetry of the circuit arrangement, which makes it easier for the operator to see what he is doing.

5. Greater safety has been obtained without the use of a large number of protective screens. When maintenance work is being done on a de-energized part of a circuit, with that or adjacent circuits in service, there are fewer exposures to the energized parts.

6. A smaller amount of excavation is needed when the rack is built on sloping property, since the buses and breakers may be installed at different elevations. In making provision for future positions within the rack it is necessary to carry the buses and fences only, through the vacant positions. All structures and equipment can be added later when the circuit is installed. The circuits may be dead-ended on either side of the rack without changing the structure.

7. Using the same amount and kind of apparatus and with the same dead-end stresses, the new rack is cheaper to build because it requires less steel, fewer insulators and no protective screens.



Pedestal-mounted tubular bus heretofore used on 220-kv. now adapted to 66-kv. stations at large saving in cost

Sliding expansion support and details of bus joints and mounting

the transformer circuits, were mounted near the top of the dead-end structure, so that only short connections to the incoming circuit and to the tops of the line disconnecting switches were required. This construction is shown in an accompanying illustration. The oil-insulated potential transformers, also used only on the transformer circuits, were supported on steel racks and located under the dead-end structure, so that a vertical connection could easily be made from the bushings to the horizontal connection between the tops of the line disconnecting switches.

Connections throughout the rack are of 1-in. outside diameter copper tubing, except on transformer circuits, where 1-in. iron pipe size tubing was used. The main buses consist of 20-ft. sections of 2½-in. outside diameter copper tubing pressed into 3-ft. sections of 2½-in. inside diameter tubing clamped to the top of the insulators. The smaller tubing was pressed into the larger for a distance of 6 in., making the spans 22 ft. between bus supports. The circuit taps were clamped by the same fitting which holds the bus, since the supports occur only at the taps. This clamp fitting was designed to slide on top of the supports and, except for one point in the middle of each bus section which was fixed, the remainder of the bus is free to move longitudinally with reference to the supports. One of the accompanying illustrations shows details of this mounting clearly. In a 440-ft. section of bus a movement of 2½ in., due to expansion, has been observed at each end with the middle stationary. The same type 73-kv. single-unit insulators were used on the disconnecting switches and buses.

Another interesting development at La Fresa is the installation of hydrogen-cooled, outdoor, synchronous condensers. The first 50,000-kva. unit is now being designed and will be placed in operation early next year. A hydrogen-cooled, outdoor unit was chosen because of its higher efficiency, which justifies its additional first cost, and because no building or special housing is required. Auxiliary apparatus will be located in a pit under the condenser and switching equipment will be of the outdoor type. Condenser control will be provided for complete automatic starting.

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Factors of Safety in Dual-Purpose Lighting

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Flexibility in the relative proportions of light and of biologically important ultraviolet radiation is desirable. But this is not essential in an actual installation, provided the required threshold exposure is obtained in a reasonable time. Inasmuch as duration of exposure and intensity of light and of ultraviolet radiation are intimately involved, installations must be designed so that those exposed will receive the required threshold exposure in the minimum time during which they are exposed to the lighting. In the work-world this duration of exposure is known.

For example, let us assume one hour as the minimum period during which workers are exposed to dual-purpose lighting. The necessary daily dosage is certainly a fraction of that which produces a minimum perceptible erythema (MPE) upon untanned skin. Suppose this fraction is one-tenth. Then, if the installation is so designed that one-tenth of an MPE dosage is obtained in an hour, untanned skin could stand at least ten hours.

The face and hands are more adapted to ultraviolet than is untanned skin, and there is no proof as yet that the biological effectiveness of ultraviolet is appreciably lessened by the greater pigmentation. This increases the factor of safety to more than ten. Therefore, it is seen that the physiological factor of safety is apparently great enough.

Where the necessary threshold time must be less than an hour, the factor of safety in the exposure time is reduced. Such installations must be designed with consideration given to the possibility of harm to those who might remain under the dual-purpose lighting for several hours.

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Cost of Air Conditioning in Department Stores*

By WILLIS H. CARRIER
President Carrier Engineering Corporation
Newark, N. J.

It has been found that the average human being, at rest, has a heat output of approximately 400 B.t.u. per hour, the approximate equivalent of a 120-watt electric light, and this remains remarkably constant through all normal ranges of temperature and moisture variation and changes of clothing.

The balance of the heat not taken care of by radiation and conduction through the clothing must be taken care of by evaporation through perspiration. Therefore, the evaporation from the human body, assuming constant metabolism, depends entirely on radiation and convection, and this in turn is affected by the temperature of the surroundings and the clothing. At a temperature of 70 deg. a normal man at rest, normally clothed, will transmit about 76 per cent of his bodily heat as sensible heat by radiation and convection, while the balance, approximately 24 per cent, will be dissipated through evaporation of perspiration and from the lungs. This proportion is apparently in no way affected by the relative humidity of the surrounding air. Similarly, at 86-deg. temperature about 38 per cent will be sensible heat, while 62 per cent will be removed by perspiration, and at about 100 deg. dry bulb temperature all the heat in the human body must necessarily be removed by perspiration.

The system used in cooling for comfort in auditoriums, department stores and other places of human occupancy is one in which the humidity can be controlled independently of the cooling effect, so that definite conditions both of temperature and of humidity are produced whatever the external variations of heat or of human occupancy. This is accomplished without varying the volume of air circulated and without the addition of any artificial outside source of heat. The air introduced into the auditorium need never be below 65 deg. F., thus avoiding cold drafts.

Air conditioning has proved its worth in the department store. One store made an initial investment of $250,000 for air-conditioning equipment in its bargain basement and first floor and found its reaction on employees, patrons and sales so definite that on the expansion of the store another $750,000 was spent for air conditioning. This was followed by other stores, with equally favorable results. Yet out of the 500 or more large department stores in this country there are only a dozen or so which have the advantage of conditioned air, and there are not even that many now conditioned in the 1,000 or more medium-sized stores in which the system will prove profitable.

A whole modern ventilation system in an office building costs about as much as a heating system, while the necessary refrigeration for complete air conditioning, in addition to ventilation and heating, will increase these installation costs by about 50 per cent. In other words, in a complete air-conditioning plant we may charge about one-third to heating, one-third to ventilation and one-third to refrigeration.

Interest and depreciation, based on the first cost of the plant, cost of maintenance and repairs, cost of power, cost of fuel or steam and cost of the condensing water for the refrigerating machine, have been taken into account and proper allowance made not only upon calculations, but upon experience in actual installations.

In the accompanying table is given the cost of complete systems of heating, ventilation and air conditioning for summer and winter. These costs give not only the unit cost for the installation, but the actual cost of depreciation, interest and operation. The power costs are given as a separate item.

**Based on paper presented at Midwest Power Engineering Conference, Chicago, February 10-13.*

Air-Conditioning Demands in Department Stores

	Connected Load, Hp.		Square Feet Floor Area	Horsepower per Sq.Ft.	
	Summer	Winter		Summer	Winter
Bonwit Teller, New York	125	25	12,600	0.01	0.00198
Hudson Stores, Detroit	780	140	79,830	0.00976	0.00175
Hudson Stores, Detroit	1,525	395	233,990	0.00654	0.0017
L. S. Ayres Co., Indianapolis	404	114	78,250	0.00515	0.00146
Wm. Filene & Sons Co., Boston	620	120	79,830	0.0078	0.0015
Kerns' Dept. Store, Detroit	281	81	46,300	0.00606	0.00175
Smith-Kasson Co., Cincinnati	69.5	18.0	9,250	0.0075	0.00195
Halliburton-Abbott Co., Tulsa, Okla.	312.5	92.5	113,900	0.00275	0.000815
Sanger Bros., Fort Worth	375	95	82,700	0.00454	0.00115
Strawbridge & Clothier, Philadelphia	1,245	325	179,635	0.00695	0.00181
Titche-Goettinger Co., Dallas	345	65	75,900	0.00455	0.00086

Summer and Winter Costs for Ventilation and Air Conditioning

Type of Building	Initial Cost per Sq.Ft.	Annual Over-All Cost per Sq.Ft.	Unit Costs (Based on Annual Over-All Costs)	Power Costs Annual	Power Costs Per Kw.-Hr., Cents
Department store, 160,000 sq.ft., 6,250 people	$1.80	0.32	32 cents per year per sq.ft. of sales area	$15,923	3
Office building, 325,000 sq.ft., 2,540 people	1.25	0.19	1 cent per man-hour	13,896	1.2
Plant office building, 42,560 sq.ft., 300 people	2.00	0.31	3 cents per man-hour	2,694	3
Restaurant and cafeteria, 12,644 sq.ft., 760 people	3.60	1.16	1 cent per meal	4,748	3
Hotel guest rooms, 120,000 sq.ft., 600 people	1.50	0.50	20 cents per room per day	13,600	3

Heat Insulation Cuts Energy Required for Electric Galvanizing

By WALLACE G. IMHOFF
President Wallace G. Imhoff Company, Vineland, N. J.

HEAT radiation which comprises 60 per cent of the losses from electric galvanizing pots may be reduced by approximately 60 per cent and the efficiency of the galvanizing furnaces increased from 14 per cent to approximately 50 per cent by providing the proper insulating material around the sides, bottom and top of the kettle.

Tests were recently conducted on an electric galvanizing furnace which had a kettle 10 ft. 10 in. x 40 in. x 49 in. and a metal surface area of 36 sq.ft. This galvanizing kettle was set on a foundation composed of 1 ft. of concrete, on top of which was a layer of "Sil-o-cel" brick 2½ in. thick. On top of this there was a layer of fire brick 2½ in. thick and alternate 5-in. piers of fire brick and "Sil-o-cel" brick. The kettle was insulated with sil-o-cel brick of 5 in. thickness on the sides and three layers of the brick on the ends. One flat layer of ordinary red brick was also placed all around the kettle.

When the test was started, this pot held 4,400 lb. of lead and 37,800 lb. of zinc, or a total metal charge of 21.1 tons. The zinc was melted in 28 hours with an energy consumption of 2,940 kw.-hr. Each kilowatt-hour melted 14.3 lb. of metal. At a cost of 1 cent per kilowatt-hour, the cost of melting was $29.40, and at a cost of 1½ cents per kilowatt-hour this would have amounted to $44.10.

Tests for productive capacity showed that when 0.845 tons of production per hour were put through the bath it would not lose temperature. The average power used for operating at this rate was 103 kw.-hr. and the average power required when the kettle was idle without a cover was 48 kw.-hr. at a temperature of 820 deg. F. A test made at 875 deg. F., which is the galvanizing temperature, showed that 53.3 kw.-hr. was required with the kettle idle. During this test the kettle showed an operating efficiency of 48.2 per cent.

Electric galvanizing has many inherent advantages, which may be summarized briefly as follows: Uniform temperature control, resulting in reduction of dross; uniform and economical zinc coating, increase of pot life due to elimination of hot spots and better quality with less rejects; labor advantages due to less attendance required, elimination of products of combustion and lowering of room temperature, and favorable comparison of over-all costs due to the advantages mentioned.

The accompanying tables and curves give the power consumption for typical electric galvanizing furnace installations and show the saving in energy that may be effected through the proper heat insulating of these kettles.

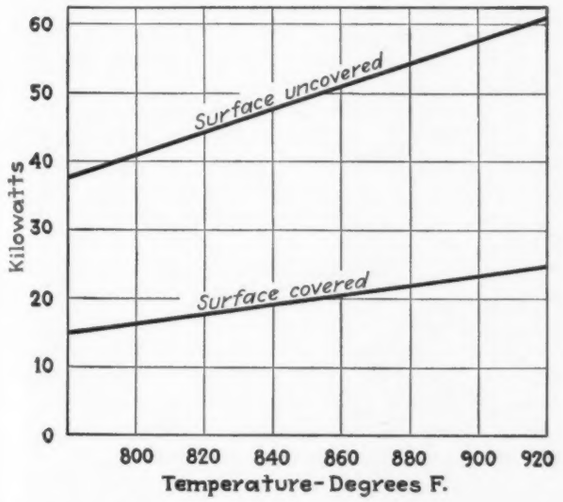

Fig. 1—More than half of radiation losses in galvanizing pots takes place at surface of metal
Kettle idle at a temperature of 820 deg. F.

*Power Consumption of Three Typical Galvanizing Furnaces**

Three different sizes of uninsulated pots are represented. The data were taken at an operating temperature of 850 deg. F.

Pot No. 1: Inside dimensions, 30 in. wide, 36 in. deep, 6 ft. long, rated 90 kw., 220 volts, three-phase—galvanizing miscellaneous steel parts.

Lb. of Steel Galvanized per Hour	Lb. Galvanized per Kw.-Hr.	Kw.-Hr. per Ton Galvanized	Cost of Power per Ton at 1 Cent per Kw.-Hr.
500	10.6	188	$1.88
1,000	15.6	128	1.28
1,500	18.5	108	1.08

Pot No. 2: Inside dimensions 36 in. wide, 36 in. deep, 15 ft. long, rated 200 kw., 220 volts, three-phase—galvanizing structural steel parts.

Lb. of Steel Galvanized per Hour	Lb. Galvanized per Kw.-Hr.	Kw.-Hr. per Ton Galvanized	Cost of Power per Ton at 1 Cent per Kw.-Hr.
2,000	13.5	148	$1.48
3,000	16.6	121	1.21
3,500	18.5	108	1.08

Pot No. 3: Inside dimensions 22 in. wide, 48 in. deep, 30 ft. 6 in. long, rated 405 kw., 220 volts, three-phase—galvanizing structural steel parts.

Lb. of Steel Galvanized per Hour	Lb. Galvanized per Kw.-Hr.	Kw.-Hr. per per Ton Galvanized	Cost of Power per Ton at 1 Cent per Kw.-Hr.
4,000	15.3	130	$1.30
6,000	18.4	109	1.09
8,000	20.4	98	.98

*Data supplied by S. M. Cherry, General Electric Company, Schenectady N. Y.

Heat Installation of Galvanizing Kettles Effects Power Saving of 60 Per Cent

In obtaining the closed-bath readings the bare metal surface was covered with about 2 in. of white skimmings and then tightly covered with a layer of "Sil-o-cel" insulating brick.

Temperature, Deg. F.	Power Required in Kw.-Hr. Open Bath	Closed Bath	Energy Saved, Kw.-Hr.	Per Cent Saving Effected
820	48.6	17.6	31.0	63.8
850	49.3	20.7	28.6	58.0
875	53.3	21.1	32.2	60.4
900	57.5	23.4	34.1	59.3

Modernize Wiring and Motors for Better Voltage Regulation

By L. L. ELDEN
Technical Adviser to the General Superintendent
Edison Electric Illuminating Company of Boston

Improved fractional-horsepower motors are now available which create less than 25 per cent of the voltage drop of older motors during starting periods. This imposes a minimum duty on wiring installations. Failure to recognize the merits of these new developments in motor design and the importance of more adequate wiring will result in many cases in poor service and economic losses which cannot be compensated for otherwise. Mr. Elden's figures on the sources of poor regulation point to conditions which should no longer be overlooked by progressive power companies.

VOLTAGE regulation of electric service for residential use has become increasingly difficult with the rapidly expanding use of household appliances. In earlier times difficulties of this character were largely due to motor-driven equipment in nearby stores and shops, whereas at present the utilization of heavy-current-consuming devices and motor-operated appliances in numerous residential installations has transferred the sources of trouble directly to these points of use.

Assuming that in general adequate capacity is supplied at all times at the customer's service switch by the utility, the outstanding causes of defective service are (1) overloaded mains, submains and branch circuits; (2) defective wiring and loose connections; (3) unbalanced loads; and (4) excessive starting currents of motor-driven appliances.

Adverse conditions of this sort are generally unknown to the utility unless discovered by periodic voltage surveys or investigation of complaints. Many of these are beyond the control of the utilities supplying the service. Even if the conditions of supply for a single customer, or group of customers, are adequate in every way, it frequently occurs that serious complaints arise from the operation of equipment in some other customer's premises which renders the service received by others most unsatisfactory.

Service complaints, aside from outages, are largely confined to complaints of fluctuating voltage, which affects the lighting service, or too-low-voltage conditions, which unfavorably affect the operation of nearly all devices.

With advance notice of the installation of household devices requiring substantial amounts of capacity for their operation, ample provision may be made for their satisfactory operation. Low voltage is rarely experienced under such conditions, except as it may be caused by the unbalanced loads frequently developed by ranges or by devices of large capacity connected to one side of three-wire mains and services.

Low voltage due to inadequate wiring is beyond the control of the utility and rests with the customer for correction.

Many older motors are trouble makers

Motor-driven appliances such as washing machines, oil burners, refrigerators, dish washers, and the like, are found to be prolific causes of fluctuating voltage in residential service. This is the direct result of the use of the older type motors requiring high starting currents, with resulting abnormal demands on system capacity at points of use. A standard ¼-hp. motor of this type will usually draw from 3 to 3.5 kva. starting current from the supply system to start itself to operate a running load of about 300 watts.

Appliances of these types are purchased from a variety of sources and are for the most part operated without previous knowledge of the utility. Service complaints follow, and the remedy must usually be applied at the expense of the utility.

The serious effect of motor-operated appliances on voltage regulation is well illustrated by test data presented herewith, as taken from one of the largest systems in the country, where every effort is made to provide adequate capacity to meet all known demands for service.

These test data unquestionably record conditions which are duplicated daily in the operation of every utility system in the country, as confirmed by observations on systems of all types, both large and small. It is not exaggerating the situation to point out that even worse results have been reported from important systems, where the maintenance of adequate distribution facilities is beyond question.

These conditions, which for the most part are unknown to operating officials until disclosed by investigations following service complaints, strongly emphasize the need of unceasing efforts on the part of all concerned to secure wiring and other facilities adequate to meet every present and future use of electric service without impairing voltage regulation.

Since motor-operated appliances contribute largely to voltage regulation difficulties, the interests of all concerned will be materially advanced by a more general use of the improved motors now available for appliance and other miscellaneous applications.

These motors, which embody all recent advances in motor design, operate at higher efficiencies and power factors than have hitherto been attainable with this class of apparatus. With starting currents limited to 15 amp. or less, these improved motors create less than one-quarter the voltage drop during the starting period that is regularly experienced with the older type motors. It

Test Data on 387 Motors Causing Lighting Fluctuations

These motors of ½ hp. and smaller rendered the lighting service of more than 2,150 customers unsatisfactory.

Number and Size of Motors	Starting Current Characteristics
7—⅛ hp.	71 motors = 15 to 20 amp.
13—¼ hp.	252 motors = 21 to 30 amp.
54—½ hp.	64 motors = over 30 amp.
2—¾ hp.	
286—1 hp.	
25—1½ hp.	
Total 387	

Measurements at customers' main service switches:

33 motors caused	1 to 5 volt fluctuations
89 motors caused	6 to 10 volt fluctuations
71 motors caused	11 to 20 volt fluctuations
4 motors caused	21 to 30 volt fluctuations
Total 197	

In 150 tests at the motor location where starting currents exceeded 15 amp., the service voltage (115 volts) fell below 100 volts in 51 cases and in 99 cases to values slightly over 100 volts. As these motors were connected in nearly all cases from an outlet on a branch lighting circuit, the lights on that particular circuit are subjected to violent fluctuations.

Location of motors:

213	in shops and factories in residential districts
128	in stores and markets in residential districts
45	in residences and apartments
1	in apartment building (central refrigerating plant)
Total 387	

Motor-Starting Currents and Overloaded Wiring Cause Complaints

Total number of complaints analyzed	178	
Complaints of low voltage, dim and flickering lights	167	
Causes—motors with excessive starting currents:		
Used by complainant	11	
Used by another customer in same building	42	
Used by another customer on a separate service	10	63
Approved motors on overloaded wiring:		
Used by complainant	5	
Used by another customer in same building	8	13
Pulsating current due to refrigerator motors	8	8
Complaints where no motors were involved:		
Causes—overloaded mains and submains	27	
—overloaded mains only	13	
—overloaded submains only	35	
—overloaded branch circuits	8	83
Complaints of blown fuses:		
Due to overload	9	
Due to high motor starting current	2	11
Total complaints		178

Household refrigerators contributed the following trouble:

High-starting current motors	9
Motors on overloaded wiring	11
Pulsating currents	8
Total	28

will be obvious that their operation will impose a minimum duty on any wiring installation, and in fact their use may be permissible on many otherwise inadequate wiring installations.

Failure to recognize the merits of these new developments in motor design and operating characteristics must inevitably result in a heavy economic loss to the industry which cannot be compensated for in any other direction. Results either favorable or unfavorable will multiply rapidly with the rapidly increasing appliance load according to the policy pursued.

Progress may best be made by insuring the use of improved motors on all appliances. Adequate wiring will then insure satisfactory service for all concerned.

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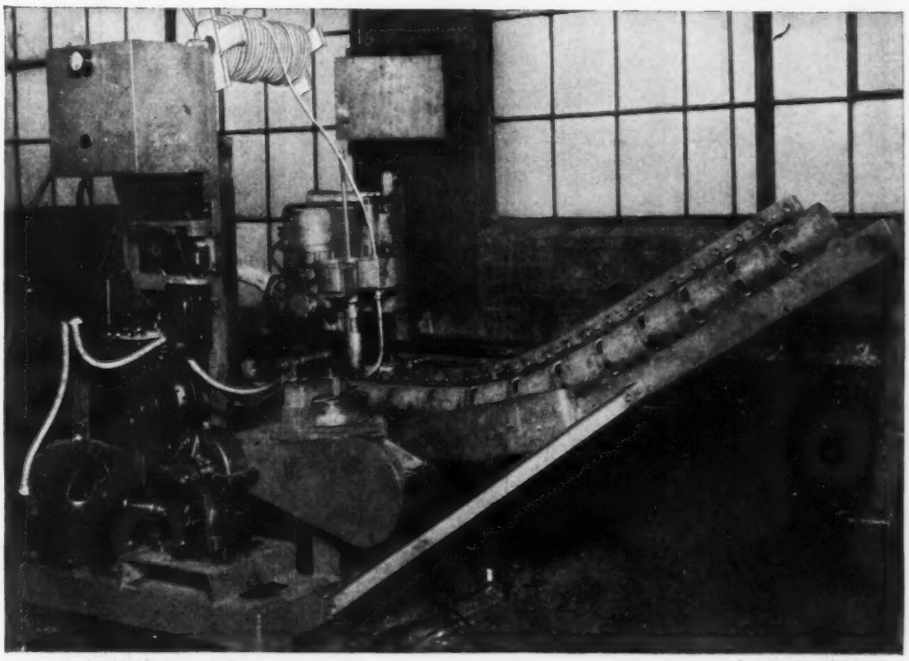
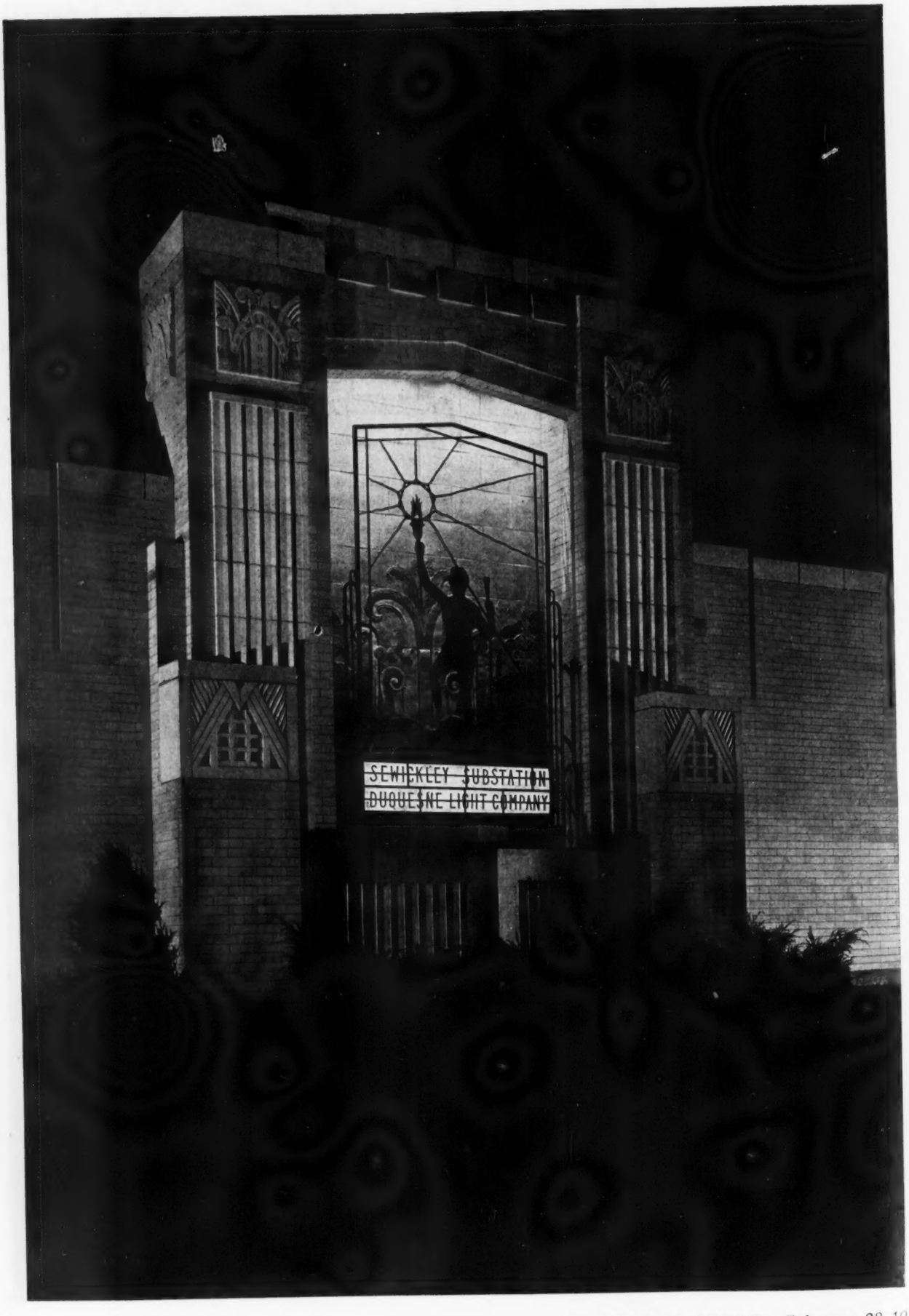
Production Line Arc Welding Cuts Automobile Makers' Costs

This automatic arc welder has a capacity of approximately 240 automobile starter and generator frames per hour and one man and a helper can operate four machines simultaneously, giving an extremely low cost per frame. With average cost of labor and material, the cost of welding frames will, in general, be approximately ½ cent each.

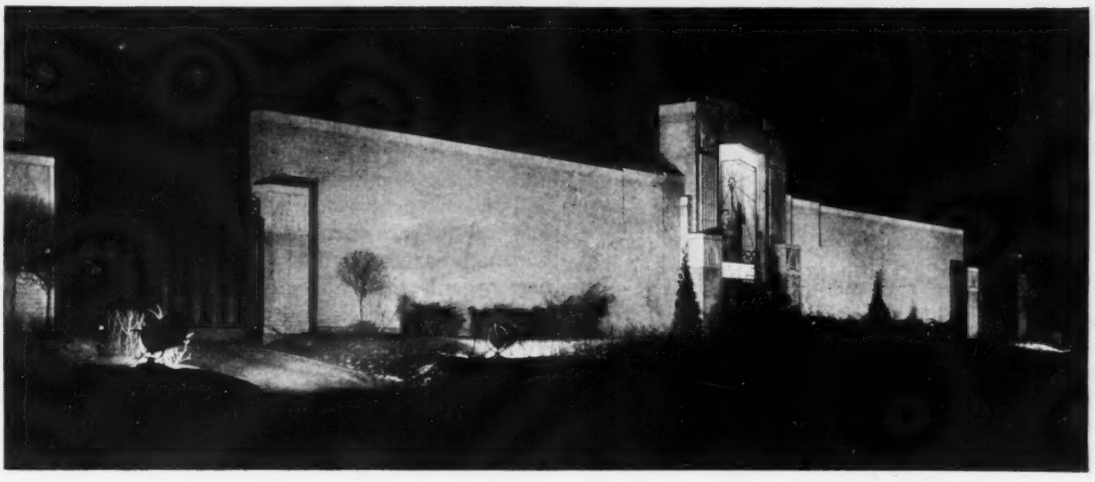
The frames are usually of $\frac{5}{16}$ or $\frac{3}{8}$ in. plate which is cut to size and shape, punched and rolled into cylinders before being arc welded. After this the cylinders are fed into a gravity conveyor, being guided automatically so as to keep the seams on top. At the bottom of the gravity conveyor they go between two rolls which squeeze the seams together tightly as they pass under the arc. No filler rod is used, the two edges of the seam being fused together by the electronic tornado process.



Lincoln Electric Company


SEWICKLEY SUBSTATION
DUQUESNE LIGHT COMPANY

Decorative Floodlighted Wall



Blends Outdoor Switchyard Into Community

THE problem of making the outdoor substation switchyard with its harsh-lined, naked skeleton of steelwork fit into a high-grade residential community without creating visual conflict has been solved with notable success at the Sewickley substation of the Duquesne Light Company, Pittsburgh, Pa.

This was accomplished by combining a monumental type of wall across the front of the property with a design constituting a memorial, to the industry of which the station is a part, as the centralized feature. In designing the main body of the wall no attempt was made to conceal the steel structures behind it. It was felt that there should be no endeavor to hide the fact that the element involved was a substation, but rather an attempt to raise the substation to a level where it becomes a desirable addition to the community by striving for an interesting treatment of an obvious usage. This keeps faith with the architectural traditions of honesty in design and avoids the undesirable psychological effect of a blank-concealing wall, which tends to arouse curiosity in the minds of observers as to what may be hidden behind it. The wall is of brick trimmed with terra cotta, both materials being of a light shade of buff, almost cream, in color, giving a richness and warmth. The brick is laid with narrow joints, the mortar being tinted to conform to the color of the brick.

For the central motif a symbolical grille work is mounted before a polychrome terra cotta which forms the surface of the rear wall of the niche. An arboreal or plant design is superimposed on a background consisting of dark green at the base and ranging through varying shades of blue to a horizon where it meets a sky of mottled buff.

In daylight the grille, being of wrought aluminum, stands out brightly against the polychrome background. At night the effect is emphasized by colored display lighting. The lighting is arranged to simulate the approach of dawn. A rose-tinged light at the horizon line extends upward and fades into a pale mottled greenish blue, which in turn dissolves into the deeper blues and purples of the lingering night.

Foreign Capital Revamps South American

By EMIL L. JORDAN

Formerly Economist International Public Service Corporation, New York

BEFORE the war the public utilities of South America showed little uniformity in financial structure. The supply of energy of the big cities was controlled by European capital, predominantly British, whereas German and French capital participated in a limited measure. As the concessions were favorable, foreign capital took advantage of the opportunity without following or consciously intending a policy of expansion. In their field of activity the different foreign corporations were mostly local and were not connected financially.

Geographically the important towns were isolated, economic relations restricted and traffic connections primitive. The country surrounding the cities was too sparsely populated to be considered for electrification. Hydro-electric power existed in profusion in Brazil and in the Andean region, but was reached only with difficulty. Besides this, British coal and shipping interests favored the construction of steam power plants. As most of the larger cities are situated at the coast, coal could be supplied directly from steamers.

Municipal and state units participated in the public utilities only in rare cases, as capital and experience were not available. However, a few national corporations were active in the electric and gas fields.

This picture was changed fundamentally after the war, and especially within the last five years. Towns formerly situated at distances of many days apart came within the reach of hours by regular air service and rendered central administration possible for industrial enterprises at different places. Many rural towns prospered and erected their own small electric plants, which in numerous cases furnished only indifferent lighting for a few hours daily and sometimes went on strike completely. They, however, acquainted the population with the possibilities of electricity. Everywhere industries grew up, increasing the demand for power. By improvement and construction of automobile roads, the natural power resources moved within reach of the cities, and as the war had shown that the dependability of energy supply on European coal markets could produce very unfavorable consequences, hydro power utilization became a national necessity.

This internal situation now is confronted by a completely changed international capital market. Germany stands aside, and a new factor presents itself, American capital. In a few years the whole picture of South America's public utilities is changed by North American enterprise. A movement of strong concentration begins, and by the pressure of American competition also the European interests are urged into a policy of expansion, which, however, remains modest in comparison. This new organization of South and Central America's utilities is actually carried out to a high degree, although it is not yet finished.

The only country to which this trend does not refer is Uruguay. This smallest state of South America administers all its electric utilities through the government.

The financial structures of South America's public utilities differ radically from those of Europe and North America. A few financially strong corporations have the reins in their hands. Without exaggeration it can be stated that the public utilities of the whole continent are controlled and operated from four centers: New York, Toronto-London, Madrid and Zurich. The financial-electrical interests are not mingled, as is the case in Europe. Regions of activity and sources of capital are sharply divided.

The accompanying tabulation shows the large companies which dominate the public utilities of South and Central America. Besides these enterprises there are still a number of smaller foreign corporations, especially of British and Belgian origin, which, however, possess only restricted local interests and sooner or later probably will be merged with one of the big companies.

A rapid transformation has recently taken place in the public utility map of South America. Into the utility picture of isolated plants, varying in structure and ownership, separated by vast stretches of distance, there came a new factor — American capital. European capital had made a bold beginning here and there, had set up spheres of influence, largely in close relation to the electrotechnical industries. American, Canadian, European and certain local groups now develop side by side. How they are co-ordinating their effort, are standardizing policies and methods and financial structures, is here told.

Utilities

Distribution of public utility interests in Latin America

This concentric movement in South America's public utilities has given rise to many new penetrating technical problems. The individual companies are rounding out not only their properties but also their generating and distributing systems and rendering them as efficient as possible. Wherever feasible, the old steam power plants were replaced by hydro plants, and several enormous hydro-electric centrals are under construction now. The technical problems and important orders of electric material connected therewith naturally have attracted the interest of the electrotechnical industry. It is typical of the South American electric utilities that the most important representatives of the United States' electrotechnical industry take an active share in their financing and thus have secured a substantial and potential field for sales. That trade follows capital investment is a principle acknowledged everywhere today, and this is a classic example. The electrotechnical concerns in question directed their sales efforts to these regions intensively only after the energy supply of these same districts had been acquired by financially allied companies.

Co-operation between American manufacturers and American utilities has halted the old predominance of German electrotechnical material on the South American markets. It is significant that before the war the German electrotechnical industry followed a similar policy. The Siemens interests controlled several electric plants and tramways in South America, and the Deutsch-Überseeische Elektricitäts-Gesellschaft, which during the German inflation in 1920 transferred the control of the Buenos Aires district to the Spanish "Chade," was closely connected with the German electrotechnical industry. This policy, however, has been given up. Today not only all centrals but also almost all hydro resources and concessions are in firm hands, even if they can be counted on for practical utilization only in later decades.

The attached sketch shows how the spheres of public utility influence in South and Central America are distributed. At the first glance it is a striking fact that the major part of the continent cannot yet be considered at all for intensive electrification. In the large areas in the south and north of the continent outside of the marked

The Most Important Public Utility Companies in Latin America

Seat of Company	Company	Year of Foundation	Interested in	Population Served in 1929
Canada	Brazilian Traction, Light & P. C.	1912	Brasil	3,581,000
Canada	International Power Co., Ltd., Montreal	1926	Bolivia	160,000
			British Guiana	60,000
			Mexico	120,000
			Salvador	150,000
			Venezuela	150,000
			Total	640,000
Spain	Cia. Hisp. Amer. de Elec. "Chade"	1920	Argentina	2,300,000
Switzerland	Swiss-American Electric Co., Zurich	1928	Argentina	560,000
			Colombia	240,000
			Paraguay	100,000
			Peru	370,000
			Total	1,270,000
U. S. A.	American and Foreign Power Co., Inc., New York	1923	Brasil	3,785,000
			Argentina	1,906,000
			Cuba	1,478,000
			Mexico	1,278,000
			Chile	936,000
			Colombia	365,000
			Guatemala	182,000
			Costa Rica	159,000
			Panama	138,000
			Ecuador	130,000
			Venezuela	127,000
			Total	10,484,000
	Intercontinents Power Co., Inc., Harrisburg and New York	1928	Argentina	647,000
			Brazil	113,000
			Chile	95,000
			Total	855,000
	Southern Cities Utilities Co., Inc., Philadelphia	1917	Dominican Republic	120,000
			Haiti	155,000
			Total	275,000

supply districts electric plants exist, but are sporadic, unimportant and are locally financed and managed.

Leaving aside Uruguay, with its purely governmental electric utilities, the predominance of the spheres of American influence seems obvious. It must be stated, however, that the energy supply of the most populous and highest developed urban districts lies in European hands. Canadian interests are considered as British for the purposes of this article, as the seat of these companies has been transferred to Canada largely by reason of convenience, whereas the capital comes from the London money market. Thus, most of the political and economic capitals belong to the sphere of European interests, as Rio de Janeiro, São Paulo, Santos, Buenos Aires, La Plata, Bahia Blanca, Asuncion, La Paz, Bogota and Mexico City.

The participation of the different companies in the electric and gas supply of the countries of South and Central America is shown in the last two columns of the table. The figures of the population served in 1929 are only estimated, as correct figures are not available. They are, however, a good yardstick to compare the importance of the companies. Adding the British-Canadian interests to the European group, the American interests supply with electric energy a population of approximately 11,800,000, against 7,800,00 of the European interests.

Within the next few years this picture may easily show a larger American predominance. Over and over again a participation of the American & Foreign Power Company in the Brazilian Traction, Light & Power Company is unofficially mentioned and commented upon, and the connection of the two distribution systems recently inaugurated in Rio and São Paulo indeed indicates a closer co-operation. If one day we had to combine the Canadian interests with the American group, the American-European proportion would be alternated to 15,800,000 and 3,600,000.

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Costs of Installing Demand Meters

Costs of installation of demand metering for commercial customers have been submitted by the New York Edison companies in connection with the request for approval by the Public Service Commission of a new rate for this class. All the block interval registers or meters and the contactors are devices which have been approved by the commission except the thermal device for insertion within the cases of d.c. meters.

No. of Meters and Rating	Type	Contactors Included	Install, Test and Wire	Total Cost Installed
One, a.c.	Block interval, within watt-hour meter	..	$1.57	$12.74
One, d.c. to 25 amp.	Thermal, within watt-hour meter	..	1.57	7.77
One, d.c. 50, 75 amp.	Thermal, within watt-hour meter	..	2.50	11.20
One, d.c. 100, 150 amp.	Block interval, separate from watt-hour meter	1	4.50	38.63
Two, one or both a.c.	Block interval, duplex	2	6.00	40.98
Two, d.c.	Block interval, duplex	2	6.00	44.93

The relays which serve to integrate the simultaneous demands on three or more circuits where customers use any combination of d.c. and a.c. service or use a.c. exclusively are standard devices, which, however, have not had the formal approval of the commission. The total costs per installation range from $111.83 for three meters to $337.76 for sixteen meters. These figures are from one-fourth to one-third the values for installation of approved devices. The prices cited include contactors (ranging from $33.75 to $189), relays (at $36 for three to six meters and $72 for seven to sixteen meters); also installation, testing and wiring costs, which range from $15 to $57 per installation of three to sixteen demand meters.

R. H. Tapscott, electrical engineer of the Edison company, testified that his estimate of the cost of providing and installing these demand-measuring units was on the basis of putting in 139,275 of such installations practically as a single operation, within a period of a few months, and that the costs would not apply to piecemeal installations. It embraces the 42,744 d.c. meters and 85,258 a.c. meters in single-meter installations and 11,273 multiple-meter installations required for present business if the Public Service Commission approves the proposed demand-charge rate for commercial customers.

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READERS' FORUM

Electronic Bypass Negligible in Lamp Bulbs

To the Editor of the ELECTRICAL WORLD:

Recently the question was asked as to the amount of electronic flow between the ends of the filament in an ordinary incandescent lamp. Undoubtedly others have wondered how much the phenomena of thermionic tubes are present in bulbs designed for illumination purposes.

A very large proportion of the present incandescent lamps are of the "Mazda" C type, which contain argon and nitrogen at a pressure, when hot, of around one atmosphere. Under such circumstances I do not believe that electronic current is anything to be considered. In the "Mazda" B type, now made only in miniature and small sizes, a phosphorus getter is used which may reduce the electron emissivity of the pure tungsten filament. If we assume a pure tungsten filament in a 25-watt, 110-volt exhausted bulb and operating at 2,450 deg. K., I estimate the bypass current would be less than 0.01 per cent of the heating current. If you could operate a vacuum tungsten filament at 2,800 to 3,000 deg. K., as we do with the gas-filled lamp of the larger sizes, this bypass current would of course be very much larger.

Some lamp filaments contain a small amount of thoria, but when the filament is operated at lamp temperature the thorium which is present to aid any electron emission from the surface does not remain there long enough to make itself felt.

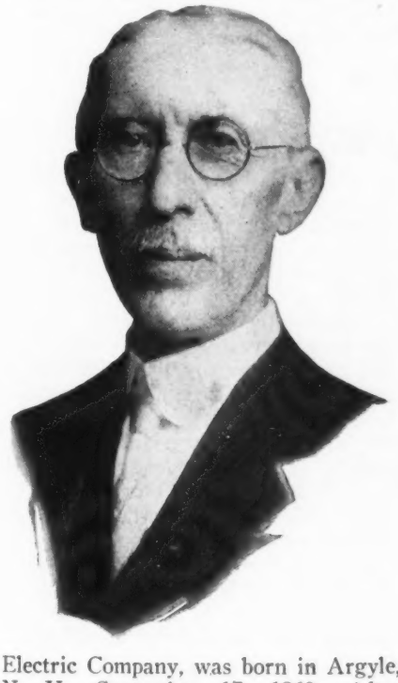
H. C. RENTSCHLER.
Director Research Lamp Research Laboratory, Bloomfield, N. J.

Men of the Industry

Lamme Medal Awarded This Year to Dr. W. J. Foster

DR. WILLIAM J. FOSTER, Schenectady, N. Y., has been selected to receive the Lamme medal of the American Institute of Electrical Engineers, "for his contributions to the design of rotating alternating-current machinery," and the medal will be presented to him at the summer convention of the Institute, which is to be held in Asheville, N. C., June 22-26.

Dr. Foster, who until retirement was a consulting engineer with the General



Electric Company, was born in Argyle, N. Y., September 17, 1860. After graduation from Williams College in 1884, he remained a year for advanced work in mathematics. During the next five years he taught high-school subjects and made an intensive study of physics. The degree of master of science was conferred upon him by Cornell University in 1891, following a year of graduate study.

In the summer of 1891 Dr. Foster began his engineering career in the Thomson-Houston Works in Lynn, Mass. He was assigned to development work on induction motors early in 1892 and to similar work on synchronous converters a few months later. On October 1, 1892, he became assistant engineer and began at that time a close association with Dr. H. G. Reist, which continued for 37 years. Beginning in 1893 and extending through several years, his association with Dr. Steinmetz was very close. During this period Dr. Foster assisted in general improvements, developed retardation tests and originated tests for measuring short-circuit losses. His drafts of test methods, involving heat runs, overloads, temperature rises, etc., were submitted through Dr. Steinmetz to the committee on standardization of the A.I.E.E. and adopted as standards.

Dr. Foster had general charge of the electrical designs of alternating-current rotating machines built by the General Electric Company during most of his engineering life. For about 25 years, beginning in 1895, he made virtually all the calculations on the most important generators built by this company. His energy was invariably directed to obtaining designs as free from losses as possible and efficiencies higher and temperatures lower than promised. He has contributed important papers to the publications of the A.I.E.E. and other technical journals. He joined the Institute in 1907 and was transferred to the grade of fellow in 1916. He served as a member of the committee on electrical machinery for ten years and was chairman during the year 1928-29.

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CHARLES S. RUFFNER has resigned as a vice-president of the Niagara-Hudson Power Corporation, but continues chairman of the board and a director of the New York Power & Light Corporation.

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S. R. INCH, a vice-president of the Electric Bond & Share Company, has been elected executive vice-president and FRANK A. REID, general attorney has been elected a vice-president.

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WALTER W. COOPER has been engaged by the California Railroad Commission to take charge of the preparation of rate cases before the commission. He will start upon his new duties not later than July 1. Mr. Cooper is a graduate of the University of Minnesota and has had wide experience in valuation with Edward W. Bemis, Milo R. Maltbie, Delos F. Wilcox and in California.

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H. H. BAILEY, formerly superintendent of power production of the Tennessee Electric Power Company, is now assistant manager of the Chattanooga district. Before his connection at Chattanooga, Mr. Bailey was identified with the Nashville Railway & Light Company for fourteen years, first as mechanical-electrical engineer and later as superintendent of power production and distribution.

F. W. Smith Elected to Vice-Presidency in Edison Company

FRANK W. SMITH, who was elected a vice-president of the New York Edison Company at the recent meeting of the board of directors, as announced in the February 21 issue of the ELECTRICAL WORLD, has been associated with the electrical industry for more than 51 years. At the present time Mr. Smith is vice-president and general manager and a director of the United Electric Light & Power Company and chairman of the board of the New York & Queens

Electric Light & Power Company and vice-president and a director of the Brush Electric Illuminating Company.

Born in Alden, Erie County, N. Y., Mr. Smith as a lad of thirteen got a job with the United States Illuminating Company, a pioneer in the arc light field. The United States company was one of the units in the merger that formed the United Electric Light & Power Company in 1889. By the time he had reached the age of sixteen he carried the title of general clerk, and in 1889, when the United company was formed, he became paymaster. At 24 he was assistant auditor and eight years later became assistant secretary. A year later he was made secretary of the Brush Electric Illuminating Company, and in 1905 secretary of the United company. In 1912 he was elected vice-president.

Mr. Smith is an active member of

the National Electric Light Association, of which he is a past-president, in 1922 having been its leader. He has been chairman and a member of a great number of its committees and has also been connected with the affairs of other electrical societies.

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E. A. Hester Assumes New Operating Duties

E. A. HESTER, formerly planning engineer of the Duquesne Light Company, has been placed in charge of the newly formed operating systems planning division of the vice-president and general manager's office, taking over the duties previously handled by E. C. Stone, for-

merly system development manager, who was promoted to the position of assistant to the president as announced in the February 14 issue of the ELECTRICAL WORLD. Mr. Hester's new duties consist of the handling of all system planning, budget control, valuation and statistics and miscellaneous economic investigation work required for the proper development of the Duquesne Light Company system. He has been with the Duquesne Light Company since 1926 as planning engineer, and previous to that time was an engineer in charge of responsible work with the Brooklyn Edison Company.

A native of Georgia and a graduate of North Carolina State College, Mr. Hester received his early training in the engineering department of the Westinghouse Electric & Manufacturing Company. With the Brooklyn Edison Company he served as assistant to the electrical engineer, protection engineer and resident engineer in charge of the construction of the Hudson Avenue generating station. In 1926 he joined the Duquesne Light Company as transmission planning engineer, and in 1927 was made planning engineer, which position he held until his recent promotion. Mr. Hester is very active in such societies as the American Institute of Electrical Engineers, National Electric Light Association, Engineers' Society of Western Pennsylvania, and others. One of his recent appointments is member of the committee of advisers on standard voltages and currents of the United States National Committee of the International Electrotechnical Commission.

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C. REA MOORE, for many years connected with the engineering staff of the Department of Public Works, Olympia, Wash., has joined the organization of the Washington Water Power Company, Spokane, and has been appointed division manager of the Okanogan (Wash.) division. He succeeds T. E. Holsey, who has been transferred to Spokane as assistant to the general agent.

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D. W. PROEBSTEL, for many years test engineer for the Portland General Electric Company, Portland, Ore., and its predecessors, has been promoted to the engineering department of the parent company, Central Public Service Corporation, Chicago. In his new position Mr. Proebstel will be assistant in electrical engineering to L. N. Boysen, who is assistant to the operating vice-president. Mr. Proebstel has been active in the American Institute of Electrical Engineers and the National Electric Light Association, having served for two years as chairman of the engineering section of the Northwest Electric Light and Power Association, in addition to executing other assignments in both organizations.

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OBITUARY

PHILIP L. ALLISON, for 27 years mechanical engineer of the Canadian General Electric Company at Peterborough, Ont., died on February 14, after a brief illness. He was born at Bergen, N. J., and graduated from the Stevens Institute of Technology. Before removing to Canada in 1904 he was connected with several electrical companies in the United States. He was a charter member of the Engineering Institute of Canada and a former member of the American Institute of Electrical Engineers.

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FRANKLIN C. ETESON, illuminating engineer for the Virginia Electric & Power Company, president of the Electrical League of Richmond and president of a recently organized Virginia chapter of the Society of Illuminating Engineers, died suddenly from a heart attack at his home in Richmond on February 19. He was 35 years old. Born in Kearny, N. J., he had been connected with the Blackstone Valley Gas & Electric Company, afterward serving as sales manager for the Keokuk Electric Company and later for the Western Electric Company at Elgin, Ill. He removed to Richmond in 1929 to take the position named above.

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ALEXANDER HAMILTON MASON, superintendent of Huntley stations Nos. 1 and 2 of the Buffalo General Electric Company, died suddenly at his home on February 18 of acute indigestion. Mr. Mason, who was in his sixty-second year, was born in Kentucky and gained his early experience in the electrical industry with various companies throughout the South. During the World's Fair in St. Louis he was assistant superintendent of erection in charge of the mechanical exhibits and at the conclusion of that event was retained in the city as chief engineer at the main generating station of the light and power company there. Following this M. Mason was made chief engineer for the Havana (Cuba) Electric Company, later returning to this country as superintendent of power production in Trinidad, Colo. He went to Buffalo in 1917 and installed the first turbine in Huntley station. He had been chief engineer of Huntley station No. 1 for the last fourteen years, and when station No. 2 was built last year he was made superintendent of both.

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J. W. BURNS, industrial agent of the Southern California Edison Company, died February 18 at his home in Los Angeles. His death was caused by pneumonia and followed a short illness. Mr. Burns, who was 60 years of age, had a prominent part in the organization of the electric companies of early days and in the later expansion and consolidation of predecessors of the Southern California Edison Company. Soon after his arrival in California in 1898 from Pennsylvania he became associated with A. C. Balch and the late William G. Kerckhoff, who in 1897 organized the San Gabriel Electric Company, later the Pacific Light & Power Company. Mr. Burns became general agent of the new company. He became a member of the Edison company organization in 1917, when it acquired the Pacific Light & Power Company.

Financial and Statistical News

THE lull in new financing, created largely by apprehension due to the soldiers' bonus bill, has undoubtedly had a salutary effect on the market after the huge volume of new issues floated during January. Much healthier conditions are said now to exist.

——UTILITY COMMON STOCKS HAVE PUSHED INTO NEW HIGH GROUND for the year, having taken a leading position in the upward movement of the past two weeks. Earnings reports for 1930 compared with those of industrials and other groups show that the utilities have maintained earnings better than any other group. At the same time the extent of the movement is generally attributed to pool operations rather than to investment of the conservative type. Short covering has undoubtedly played a big part.

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Public Service System Shows Earnings Growth

NOT A VERY LARGE INCREASE, but at least an increase, is recorded by Public Service Corporation of New Jersey in its 1930 earnings statement. Total earnings of the system were $138,161,946, against $137,086,707.

Operating expenses were reduced slightly, leaving an operating net income of $43,830,768, a gain of 3.8 per cent in a very bad industrial period. The balance for dividends and surplus was $30,163,302, against $29,544,617.

Gross earnings for December, 1930, were $12,225,783, as against $12,571,570 for December, 1929, a decrease of $345,786. Operating expenses, maintenance, taxes and depreciation were $7,354,382, a decrease of $840,265. Net income from operations was $4,871,401, an increase over December, 1929, of $494,479. Other net income showed an increase of $138,990 and the total net income was $6,018,268, an increase over December, 1929, of $633,469. Income deductions were $1,329,931, or $116,540 more than for the previous December, leaving the balance available for dividends and surplus $4,688,336, as against $4,171,407 for December, 1929, an increase of $516,929.

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Paper Manufactured 81 per Cent Electrical

THE CENTRAL-STATION INDUSTRY of Canada now includes 321 hydraulic stations with 843 hydraulic turbines totalling 5,214,336 hp. Of these, 222 stations, with a combined installation of 3,803,288 hp., are owned by commercial organizations (joint stock companies or private individuals) and 99 stations, of a combined installation of 1,411,048 hp., by municipal organizations or provincial commissions.

In connection with the use of water power in the Canadian pulp and paper industry, it is interesting to note that of the 579,826 hp., more than one-half, or 296,843 hp., is connected to electric generators. In addition to the hydraulic installation of 579,826 hp., water power is the source of the energy purchased from central electric stations to operate electric motors of a combined rating of 944,272 hp., giving a total electrical utilization by the industry of 1,241,115 hp. out of the total hydraulic utilization of 1,524,098 hp.

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Louisiana Power & Light Sells Issue

A $3,000,000 ISSUE of first mortgage 5 per cent gold bonds was sold this week by the Louisiana Power & Light Company at 98 and interest to yield 5.14 per cent. The bonds mature in 1957. The company serves 119 communities, including a widely diversified group of industries.

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Insulls Engage Theatre for Stockholders' Meeting

ANNUAL meetings are really stockholders' meetings again, if the case of the Insull companies is typical. The Chicago Civic Theater was engaged to take care of the stockholders of Insull Utility Investments, Inc., and Corporation Securities Company. Evidently pains were taken to answer all questions and questions were unhesitatingly asked. Answers to these questions helped to throw light on the corporate relationship of the various units of the system. These two companies were not organized to trade in securities and make a cash profit, but for the purpose of acquiring a sufficient percentage of the securities of the principal Insull utility companies in order to be able to influence their management. The original idea in forming Insull Utility Investments, Inc., was to prevent the passing of local control of the Insull companies to group control, as was happening to many leading utility companies.

Relative to the year's business and the prospect for 1931, Samuel Insull said:

"Last year was not very satisfactory for business as a whole, but that general condition affected the utility business to only a very slight extent. The utilities that we are particularly interested in had a very satisfactory business, so far as net returns to the stockholders are concerned.

"Now, I suppose it is a natural question to ask what is going to happen in 1931. We can only judge the prospects of the future by the experience of the past.

"Our people have got over the panicky feeling toward prices of securities and commodities and are adopting a far more sane point of view as to conditions. We have been saving, as a people, a great deal of money during the last year. As people find their money is unemployed, it is natural to assume there will be efforts in the direction of development and, consequently, the expenditure of capital during 1931 that was absent in 1930.

"Taking a world view of the situation and seeking the troubles that other people are in, it is quite evident that if our country's business is to improve we must be satisfied with the business that can be developed within our own borders. I see no reason why there should not be sane development. Within our own borders we have all the capital that we possibly can require."

NEWS BRIEFS

All of the outstanding first mortgage 30-year 5 per cent gold bonds, series A, of the Kansas City Power & Light Company have been called for payment April 6 at 105 and interest.

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Puget Sound Power & Light Company has omitted the quarterly dividend of $1 a share due on the common stock. Regular quarterly dividends were declared on prior preferred and preferred.

•

Ohio Brass Company and subsidiaries for 1930 had net profit of $1,817,518, equal to $4.88 on combined class A and B common shares, against $2,823,057, or $7.77 a share, on the combined A and B common stock in 1929.

•

Detroit Edison Company has called for payment March 1 at 105 and interest all of the outstanding first and refunding mortgage gold bonds, series A and series B, due July 1, 1940.

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Ten thousand shares of Nebraska Power Company preferred stock were recently sold locally in a single day by employees. This is said to be the record campaign for any company in the Electric Bond & Share group, in an experience covering thirteen years.

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$1,390,000,000 Invested in Canadian Water Power

THE CAPITAL INVESTMENT of Canada's present hydraulic installation of 6,125,012 hp. has been the subject of intensive study, and the Dominion Water Power Bureau, in its latest bulletin, is authority for the statement that this investment amounts to almost $1,390,000,000. Of this amount, $1,168,000,000, or over 84 per cent, has been expended on lands, buildings, plant and equipment. This is greater than the capital investment of any other manufacturing industry in the Dominion.

The total installed horsepower has grown from 890,489 at the beginning of 1910 to 6,125,012 at the beginning of 1931; central electric station installation from 586,502 to 5,214,336 and the pulp and paper installations from 115,042 hp. to 579,826 in the same period. The total hydraulic installation of the Dominion now averages 617 hp. per 1,000 of population, a figure which places Canada in an outstanding position among the water-power-using countries of the world.

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December Earnings at 1929 Level

DECEMBER operations of the electric light and power industry show a gross revenue of $191,920,000, according to returns received by the ELECTRICAL WORLD. This is 2.4 per cent more than the earnings for November, differs negligibly (0.1 per cent less) from December, 1929, and exceeds December, 1928, by 6.4 per cent. As in 1929, but contrary to the usual movement, average daily earnings were slightly lower than in November. A corresponding slight decrease in operating expenses compared with the preceding year leaves the net earnings on the same level as in 1929.

The month's energy output, 7,567,874,000 kw.-hr., exceeded the amount in November, but the average daily output was slightly less. It was less than in December, 1929, by 5.4 per cent, but more than in 1928 by nearly 1 per cent.

Of the total, 2,153,620,000 kw.-hr., or 28.5 per cent, came from water power, against 2,582,844,000 kw.-hr. a year ago. That is, compared with December, 1929, the hydro-electric output decreased by 17 per cent, while that from fuel was almost identical in both months. The comparison shows the effect of the extreme lack of rainfall during 1930, especially as 1929 was itself a dry year.

Regionally the Middle and South Atlantic States and the West North Central show an increase in revenue over that of the corresponding month in 1929; in November only the second of the three had reported a gain. The Pacific Coast section continues slightly above the preceding year's level. In other sections the revenue was less, but the showing is on the whole more favor-

Regional changes in revenue and output

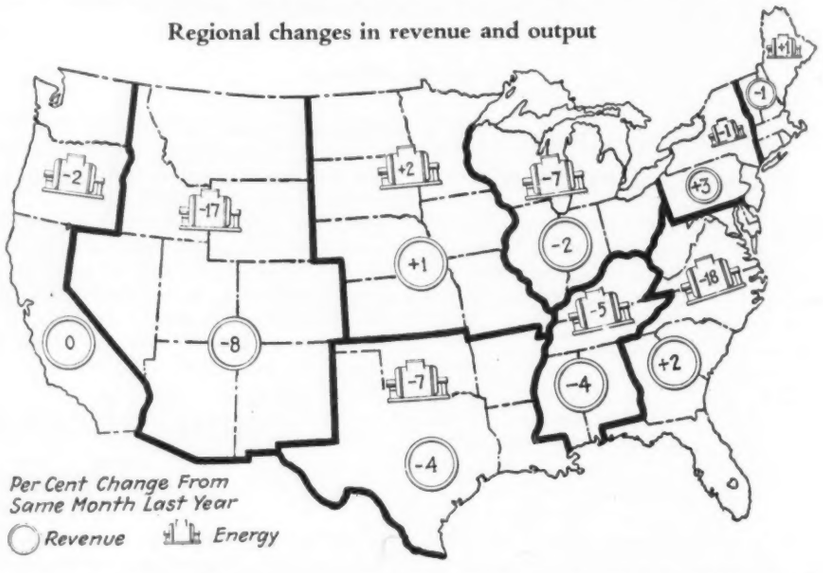


Table I—Central-Station Financial Operations in the United States[1]

Compared with Corresponding Month of Previous Year

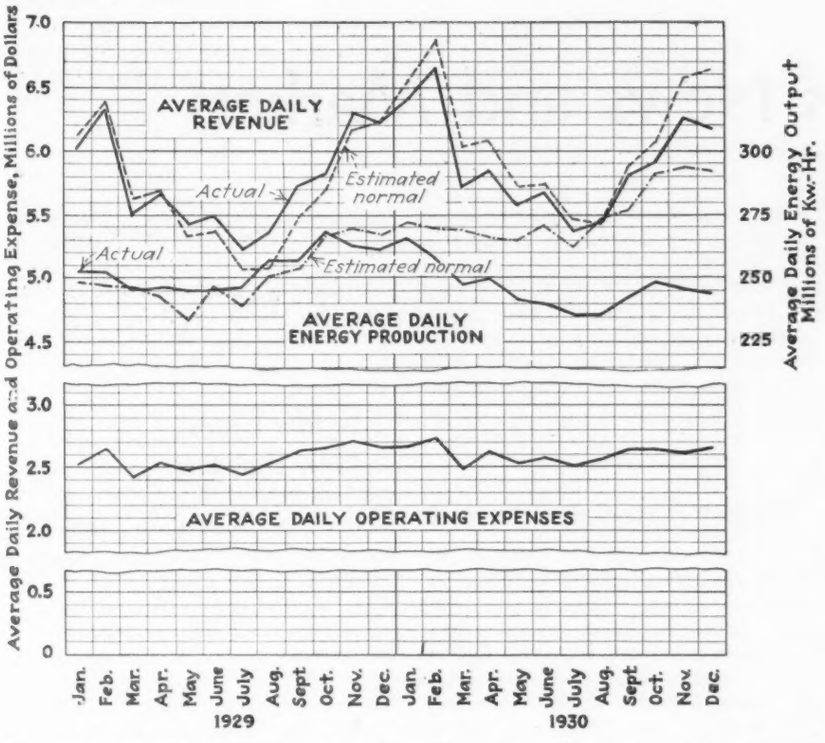
Month	Total Gross Revenue from Sale of Energy*			Total Operating and Maintenance Expense†		
	1930 Thousands	1929 Thousands	Per Cent Inc.	1930 Thousands	1929 Thousands	Per Cent Inc.
September..	$174,940	$173,600	+0.8	$78,800	$78,490	+0.8
October....	182,950	182,500	+0.2	81,640	82,540	—1.1
November..	187,340	190,200	—1.5	78,840	80,930	—2.6
December..	191,920	192,200	—0.1	82,520	82,680	—0.2

Table II—Central-Station Fuel Consumption in the United States‡

Compared with Corresponding Month of Previous Year

Month 1930	Coal		Oil		Gas	
	Short Tons	Per Cent Increase	Barrels	Per Cent Increase	Thousands Cubic Feet	Per Cent Increase
September....	3,479,386	—4.1	810,034	+ 2.8	10,541,615	—5.5
October.....	3,686,412	—2.2	865,295	—17.6	10,412,594	—16.0
November....	3,415,430	—2.2	749,528	—34.6	9,721,224	—15.3
December....	3,545,113	—4.4	810,139	—24.7	10,037,098	+0.3

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.
†Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions. ‡As collected by U. S. Geological Survey.
(1) The financial statistics for 1929 have been revised as explained on page 665 of the issue of March 29, 1930.



Revenue in 1930 averaged above 1929. Output now 16 per cent below normal

able than in November; the industrial Middle West cut its deficiency in half, with a rise approaching 4 per cent over the November revenue. In the Mountain States alone was there a further drooping from previous conditions, the month's earnings being down 8.1 per cent, whereas in November the same companies reported earnings 5.5 per cent less than in 1929. In view of the 12.5 per cent decrease in output reported for November the December decline in revenue is not surprising.

Regional operations are shown in detail in Table IV; the changes from 1929 in energy production and in revenue reflect the industrial situation in various parts of the country.

Table III—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1930	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
September	7,285,807	—3.6	2,036,309	—9.7	5,249,498	—1.1	1,980,000	+10.6
October	7,686,787	—6.2	2,068,105	—17.9	5,618,682	—0.9	2,190,000	+11.8
November	7,206,214	—7.2	1,991,684	—19.1	5,214,530	—1.7	2,050,000	+9.1
December	7,567,874	—5.4	2,153,620	—16.6	5,414,254	—0.9	1,880,000	+7.0

Table IV—Regional Operations, Revenue and Energy Output in November, 1930

Compared with Corresponding Month of Previous Year

Region	Revenue[1]		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	191,920	—0.1	7,567,874	—5.4	2,153,620	—16.6	5,618,682	—0.9
New England	19,410	—1.1	534,253	+1.1	161,962	+28.5	372,291	—7.4
Middle Atlantic	52,140	+3.0	1,974,313	—0.8	352,259	—30.7	1,622,054	+9.4
East North Central	46,990	—2.3	1,850,917	—6.9	123,864	—18.8	1,727,053	—5.8
West North Central	16,100	+1.2	490,931	+2.0	91,587	+7.5	399,344	+0.8
South Atlantic	20,360	+1.5	841,490	—17.6	358,206	—40.3	483,284	+13.9
East South Central	6,290	—3.9	276,669	—4.6	204,682	—9.8	71,987	+14.3
West South Central	9,770	—3.5	387,548	—6.8	6,098	—5.0	381,450	—6.8
Mountain	4,270	—8.1	258,538	—16.8	195,464	—22.3	63,074	+5.8
Pacific	16,590	+0.3	953,215	—1.7	659,498	+5.3	293,717	+16.9

* By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station operations.

(1) The revision of the statistics on revenue is discussed in the issue of March 29, 1930, on page 665.

Wants House Inquiry Into All Holding Companies

REFERRING SPECIFICALLY to public utility holding companies, Walter M. W. Splawn, counsel for the House committee on interstate and foreign commerce, has recommended that the scope of the investigation originally authorized by the House into railroad holding companies should be broadened to include all holding companies engaged in interstate commerce. Pointing out that the holding company as an agency in interstate commerce is not confined to railroad transportation, but that its use has been more varied in other fields, Mr. Splawn said that before deciding whether to regulate the holding company "in certain of its uses or abuses" the committee should be fully informed as to the exact nature of this device and what its economic advantages and disadvantages are with respect to the character of business in which it is used.

Investigation by the House committee into the status and operations of holding companies in the public utility field was advocated by Mr. Splawn to supplement the investigation that the Federal Trade Commission is conducting on behalf of the Senate. Mr. Splawn does not urge hasty enactment of legislation for regulation of the holding companies. Remarking that the commission's investigation will probably run for three years, he suggested that the vast quantities of data which that investigation has accumulated should be analyzed by the House committee just as, he said, the Senate committee will no doubt have the data in his report analyzed in connection with the findings of the Federal Trade Commission. Mr. Splawn also recommended that the committee should inquire into holding companies in business other than that appertaining to railroads and public utilities.

"If federal regulation of the holding company is necessary," said Mr. Splawn, "the reasons for that necessity should be clear, the evils to be remedied should be apparent, and the scope and the limits of desires and possible federal control should be clearly set forth. Necessary protection should be afforded, in so far as that is possible under federal regulation, to those who would otherwise suffer, without interfering with or placing undue burdens upon legitimate and desirable business activity. Formulation of such legislation will require a comprehensive and prolonged study by this committee as preparation for the extensive hearings."

Mr. Splawn's recommendations were made in a report on his investigation into the stock ownership in railroads submitted to the House committee on interstate and foreign commerce on February 20.

Business News and Markets

Claude Neon Sales Well Sustained

CLAUDE NEON LIGHTS, INC., reports that consolidated sales by itself and its associated companies in the United States for the year ended December 31, 1930, amounted to $15,349,497. For the year 1929 total sales were $15,778,893.

Reports so far received for 1931 indicate that sales this year will show an increase over the corresponding periods of either 1929 or 1930.

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New Equipment to Serve Harvard

NEW AND IMPROVED power station equipment to meet the increasing demands for service in connection with its recent contract for the entire power and steam heating requirements of Harvard University has been installed for the Cambridge Electric Light Company, which is part of the Associated Gas & Electric system.

The new equipment includes two Stirling boilers designed for 448 lb. steam pressure, a 12,500-kw. turbine and a special 2,500-kw. back-pressure unit which acts as a reducing valve for the steam for heating the buildings of Harvard University and several small industrial plants. In order to accommodate the new equipment, alterations were made to the power house.

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Vulcanized Fiber Specifications Issued

STANDARD DIMENSIONS, tolerances and specifications for vulcanized fiber, sheets, tubes, rods and rolls are given in a revised pamphlet just issued by the National Electrical Manufacturers' Association. The specifications give standard values for mechanical and dielectric strength, specific gravity, hardness and water absorption and the methods to be used in testing.

This pamphlet supersedes the third edition, issued in January, 1930. It contains several new rules on tolerances for diameters of vulcanized fiber tubing and rods, standard length of sheets, and minimum dielectric strength for thin-weight fiber and fish paper.

The standards were formulated by the vulcanized fiber section of the association, whose membership comprises a preponderance of the manufacturers of this material in the United States. Copies may be obtained by applying to the National Electrical Manufacturers' Association, 420 Lexington Avenue, New York.

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Export Association

FOR THE PURPOSE of exporting electrical equipment and goods, the Electrical Apparatus Export Association has filed papers under the Webb-Pomerene law, the export trade act, with the Federal Trade Commission. The association will maintain offices at 120 Broadway, New York.

Officers of the association are: George H. Bucher and George H. Magner, managers; H. F. A. Schoenfeld, manager and supervisor. Members of the association are: Westinghouse Electric International Company and the International General Electric Company, Inc., New York City.

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Biddle Issues New Bulletins

FOUR AMPLY ILLUSTRATED BULLETINS dealing with recent developments in the instrument field have been issued by James G. Biddle Company of Philadelphia. One discusses Frahm frequency meters, showing the operation of these instruments in considerable detail. Another describes "Jagabi" speed-measuring instruments; a third, the 1,000-volt "Super-Meg" insulation tester, and the fourth, "Pointolite" lamps. All are thoroughly descriptive and include price lists.

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Success of New Cable Featured in Baltimore

UNDER the head of new features established during the year, the report of the Building Department of Baltimore, Md., for the year 1930, recently published, gives specific credit to the improved armored bushed cable as a type of wiring which has been helpful in increasing the department's record for providing the public with greater safety in building construction. During the winter of 1928-1929 the Electrical Inspection Department of Baltimore placed severe restrictions on the use of the braided type armored cable, claiming it was a fire hazard for use even in the outlying residential districts.

In the spring of 1929 the armored cable industry announced a new type Kraft paper-wrapped cable with heavy metallic armor and provided with insulating bushing between the conductors and the armor at each termination of the armor. Due to the interest and combined support of the electrical industry, including central stations, contractors, wholesalers and inspectors, a revised code made mandatory the use of only the bushed type where armored cable was used.

In the report Walter G. Hammond, building engineer, stated that the cable is now deemed as acceptable in high-risk districts as in other parts of the city.

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Westinghouse Orders

AN ORDER AMOUNTING to well over $100,000 has been placed with the Westinghouse Electric & Manufacturing Company by the Southern Sierras Power Company for three 5,000-kva. power transformers for the San Bernardino substation.

The company also announces the receipt of two orders for a large turbine-driven dredge and auxiliary equipment. Two 20-in. hydraulic dredge pumps, each driven by a 550-hp. Westinghouse geared turbine, together with condensers and auxiliaries, including a 300-kw. turbine generator unit, were ordered by O'Brien Brothers' Sand & Gravel Corporation, New York.

Leatham D. Smith Dock Company of Chicago placed an order for a 1,200-hp. geared turbine and a hydraulic dredge pump rated at 31,000 gal. per minute

against a 78 ft. head, for installation in a dry, self-unloading hopper dredge, the third of its type in the world.

The new Kanawha Power Company, a subsidiary of the Union Carbide & Carbon Corporation, has awarded a contract to the Westinghouse Electric & Manufacturing Company approximating $250,000.

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Year's Electrical Exports 11.6 per Cent Lower

EXPORTS OF ELECTRICAL EQUIPMENT from the United States during the calendar year 1930 amounted to $131,977,703, against $149,335,894 the previous year, a decline of 11.6 per cent. The 1930 total, however, far exceeds that of any previous year, being nearly 20 per cent over the 1928 total. The December total was down 10 per cent.

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TRADE BRIEFS

F. H. Airey, Los Angeles district manager for the General Electric Supply Corporation, was chosen chairman of the Pacific Division, National Electrical Wholesalers' Association.

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Hydrauger Corporation, Ltd., San Francisco, has appointed W. A. Kohlhoff sales engineer. Mr. Kohlhoff has been associated with the Pacific Gas & Electric Company for the past ten years.

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Bailey Meter Company of Cleveland, Ohio, announces the appointment of P. S. Dickey as research engineer.

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Pacific Northwest headquarters of the Frigidaire Sales Corporation has been transferred from Seattle, Wash., to Portland, Ore., the change having become effective the first of this year. At the same time Frigidaire Sales Corporation became a wholesale concern only and will handle its entire retail distribution through dealers.

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Robert Gair Company is installing a new 700-hp. high-pressure boiler at its Tonawanda division, Tonawanda, N. Y. The new installation will involve the expenditure of $75,000.

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New York Metal Prices

	Feb. 18, 1931 Cents per Pound	Feb. 25, 1931 Cents per Pound
Copper, electrolytic	10⅛	10⅛
Lead, Am. S. & R. price	4½	4.60
Antimony	7.10	7.10
Nickel, ingot	35	35
Zinc, spots	4.35	4.30
Tin, straits	26⅛	27⅛
Aluminum, 99 per cent.	23.30	23.30

United Engineering Earnings Up

UNITED ENGINEERING & FOUNDRY COMPANY reports for the year ended December 31, 1930, net earnings after depreciation and federal taxes of $2,114,359, equal after payment of $90,709 preferred dividends during the year, to $4.86 per share on 416,118 shares of no-par value common stock.

This is a substantial increase over the net reported for 1929, which amounted to $1,671,887, equal after dividends paid on preferred stock then outstanding to $3.75 per share on the common stock. Net earnings available for the common stock during 1930 was benefited by the retirement of 2,931 shares of 7 per cent preferred stock, par value $100, which reduced the outstanding preferred from 15,749 shares to 12,818 shares, according to a recently issued report.

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Electrical Manufacturing Up 9 per Cent

ACCELERATED activity in electrical manufacturing is indicated in the reports of energy consumption in this industry for January, received by the ELECTRICAL WORLD. Compared with December, the rise was 9 per cent. This up-turn followed a decline during the fall and early winter that carried the index down progressively from 152.2 in August to 132.4 in December, from which value it has now risen to 144.7. Gaged by the amount of energy used monthly, which in this highly motorized industry ought to be a fairly accurate measure of the work going through the shops, December activity was down 13 per cent from August; in January nearly two-thirds of the decline was recovered. The present status is 7.3 per cent lower than a year ago.

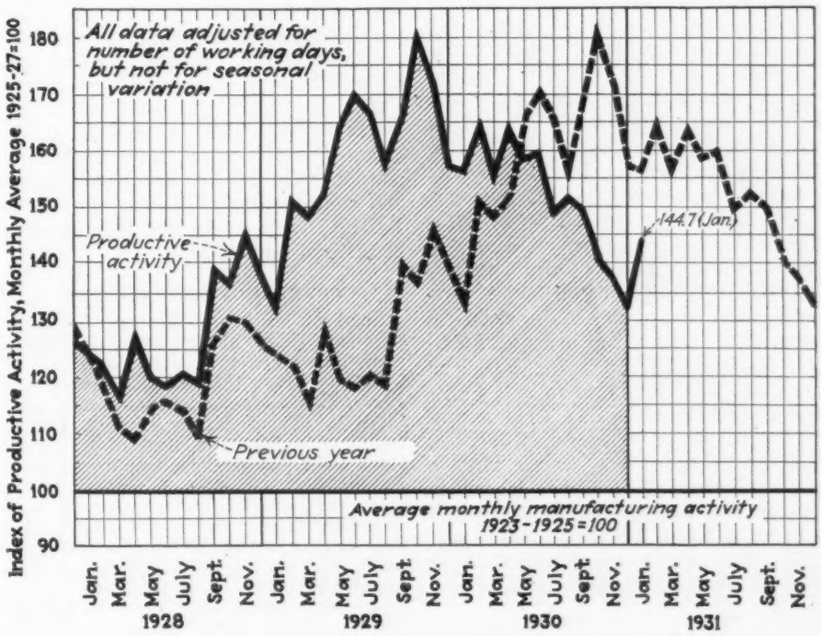
So far as the returns permit of more detailed analysis, it appears that general manufacturing as done in the large establishments — including the production of heavy equipment—has increased moderately. In fact, by far the majority of individual returns show a rise, which in several instances was pronounced. This was definitely the case in the East and to some extent in the Middle West, though in the latter section some of the figures were somewhat smaller than in December.

Branches tributary to the automobile industry gained, whereas the manufacture of domestic appliances seems to have eased after a spurt in December. Radio plants reporting seem, on the whole, to have operated at nearly the same level for the past three months, though this cannot be said of individual factories.

Comparative Index Numbers

January, 1931	144.7
December, 1930	132.4
November, 1930	*137.5
October, 1930	140.6
January, 1930	156.2
December, 1929	157.0

*Revised.



Barometer of productive activity in the electrical manufacturing plants of the United States

Market Conditions

A DEFINITE upward turn has taken place in volume of equipment sales in the Eastern district, both central stations and industrial concerns having increased their commitments. Some promising business is in sight in railway electrification. Railway equipment buying has increased somewhat also in the Middle West section and the tone of business there is slightly better.

——LONG-POSTPONED CONSTRUCTION AND REPAIR JOBS are beginning to create substantial business on the Pacific Coast. Improvement now seems very definitely in process.

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PACIFIC COAST

—LONG-DEFERRED JOBS *are being figured by contractors and orders for jobs already awarded are being placed, so that contractors and wholesalers report brisker conditions.*

—THE PAST FORTNIGHT *has been distinguished by many large awards and looking back to the early days of January, it can be seen that the improvement, though very gradual, has been decided.*

Machinery purchases include 672-kva. induction regulators valued at $20,000 for San Farancisco, a 62½-kva. generator outfit valued at about $25,000 for a gas engine company, a $60,000 switching equipment sold through the Westinghouse San Francisco office to the city of Seattle, and a $160,000 gear turbine drive sold by Westinghouse to the United States Navy. Major bids which are still being considered include $113,000 fixture bids for the Los Angeles hospital, a $55,000 bid on heavy-duty electric ranges and an $18,000 bid on smaller cooking equipment, also for the Los Angeles general hospital, whose awards have featured the past week; a $15,000 award for Eureka street lighting, and United States Navy bids aggregating half a carload of dry batteries and 36,000 flashlight batteries for various Pacific Coast yards. Major electrical construction reported includes a 25,000-kva. turbine addition to the Pasadena municipal plant estimated to cost $400,000, a year's requirements for a central California power company, a $75,000 addition to the Long Beach electric plant, and especially a $9,000,000 appropriation for Pacific Coast and Hawaii navy yard bases, air stations and barracks. The only electrical branch which continues low is industrial building and buying.

Plans for a projected $1,916,000 hydro-electric plant and a $186,000 transmisison line have been announced by Great Northern Power Company, Seattle, with the statement that construction will be started as soon as necessary engineering work can be completed and that power will be furnished by December of this year. The plant will be located in the Cascade Mountains in Snohomish County, near Everett, and a franchise for the transmission line between Seattle and Everett has been granted. Seattle jobbers have been queried on transmission wire, generators, transformers, waterwheel and accessories, but no orders, it is stated, have been placed.

Portland, Ore., has retained Carey & Harlan, city rate experts, to make a power survey costing $25,000 and the city of Tacoma is considering bids for asbestos insulation in steam plant auxiliary, ranging from $20,000 to $40,000 in cost. Two street-lighting installations, one costing about $200,000, in the Denny Regarde district, the other $13,000, in Ballard, are being considered by the Seattle City Council. Motor and apparatus sales reported included one 69-kv. oil circuit breaker to Puget Sound Power & Light Company, about $6,000 worth of miscellaneous switchgear to Puget Sound central stations, twenty motors, from 25 hp. down, to dealers and approximately 50 machines from 100 hp. down to lumber mills, veneer plants and pulp mills.

CONSTRUCTION PROJECTS

Southern Sierras Power Company, Riverside, Calif., has approved plans for a power substation at Boulder Dam to cost $250,000. Mupu Citrus Association, Santa Paula, Calif., plans packing plant to cost $100,000. Tulare Utility District, Tulare, Calif., contemplates a fund of $3,000,000 for a light and power plant, transmission and distributing system. Livermore, Calif., plans ornamental lighting system in business district, using concrete standards. Bureau of Yards and Docks, Navy Department, Washington, D. C., plans improvements in power plant at Puget Sound navy yard, Washington, to cost $75,000. Pacific Coast Steel Company, Seattle, Wash., has filed plans for a storage and distributing plant to cost $80,000. Grand Junction, Colo., plans electric light and power plant to cost $750,000. Electrical District No. 4, Casa Grande, Ariz., will proceed with construction of transmission line to cost $250,000.

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NEW ENGLAND

—ORDERS FOR INDUSTRIAL EQUIPMENT *are increasing. Small motor sales during the past two weeks reached a high level for the year in this district, according to one prominent manufacturer. Heavy electrical machinery orders are slack, but negotiations are pending. Small switch and control equipment is steady and the volume of sales reported is encouraging.*

Recently an interesting order for a 4,000-volt network system, including four 1,500-kva. transformers, special control equipment and accessories, was placed with a prominent manufacturer. Central-station requirements are attracting more interest, and according to one manufacturer inquiries are quite active for equipment for a number of additions and extensions to outside stations in this district. General schedule materials are selling in good volume and the level maintained during the past week was higher than for some time past. Inquiries for industrial heating equipment are reported by one prominent manufacturer and wiring materials for institutional type building in good volume are under inquiry.

CONSTRUCTION PROJECTS

New England Power Association, Boston, Mass., has filed plans for a power substation at Westboro, Mass., reported to cost over $60,000. Bureau of Yards and Docks, Navy Department, Washington, D. C., plans improvements in electric system at Boston, Mass., navy yard to cost $150,000; also for improvement in power plant and system at naval training station at Newport, R. I., to cost $50,000. Standard Oil Company of New York, New York, plans oil storage and distributing plant at Quincy, Mass., to cost over $350,000.

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MIDDLE WEST

—THE SLIGHT ACCELERATION *in general business noticeable at the beginning of the month in the Middle West section seems to be continuing this week; the volume is increasing gradually and better business seems quite probable. Major activities are in an improved position with some increase in employment noted.*

Various railroads are again coming into the market for a considerable amount of equipment, while maintenance purchases have increased. Retail trade is not up to expectations, due perhaps

to unseasonable weather conditions, but some improvement is in sight. Building construction work has increased somewhat and a little more optimism is being evidenced generally. The utility companies are going ahead with their construction schedules, while plans formulated for the second quarter show no decrease in activity. Some of the interesting items placed this week include three 2,000-kva. oil-insulated, self-cooled, single-phase, 60-cycle, 12,000-volt transformers, two 100-kva., 4,400-volt, single-phase, oil-insulated, self-cooled, high-voltage winding, 75,000/150,000-volt, series parallel testing transformers, and construction of substation to cost approximately $70,000.

CONSTRUCTION PROJECTS

Edison Sault Electric Company, Sault Ste. Marie, Mich., has purchased municipal electric light and power plant at St. Ignace, Mich., and contemplates extensions in transmission and distributing lines. University of Cincinnati, Cincinnati, Ohio, plans equipment shop and distributing plant to cost $100,000. Montana-Dakota Power Company, Minneapolis, Minn., contemplates extensions and improvements in power plant at Columbus, N. D., to cost about $250,000. Board of Trustees, Epileptic Colony, Cambridge, Minn., contemplates extensions in power plant to cost $150,000. Iowa Railway & Light Company, Cedar Rapids, Iowa, plans power station at Sac City, Iowa, to cost $40,000, and will extend transmission lines in Linn County. Iowa Public Service Company, Sioux City, Iowa, plans extensions in transmission lines in Woodbury, Wright and Ida Counties. Iowa Southern Utilities, Centerville, Iowa, plans extensions in transmission lines in Henry and Decatur Counties.

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SOUTHWEST

—GENERAL CONDITIONS *are the same as in the last few weeks. All agree that they are better than the same period of last year.*

Industrials are buying in fair quantity and they state that they are getting ready for a good demand on all lines in the early spring. Utilities have not bought in any quantity yet, but there are several good-sized contracts for machinery about to be closed. The only order reported is one for a synchronous motor and two transformers to cost $11,500.

CONSTRUCTION PROJECTS

Springfield Gas & Electric Company, Springfield, Mo., contemplates extensions and improvements in plants and system to cost over $200,000. Arkansas-Missouri Power Company, Blytheville, Ark., plans extensions and betterments in plants and system to cost over $400,000. Burford Refining Company, Pecos, Tex., plans oil refining plant at Longview, Tex., to cost over $150,000. Dallas Power & Light Company, Dallas, Tex., has acquired right-of-way for transmission lines around city. New Orleans, La., plans port expansion and improvement program to cost over $40,000,000.

EASTERN

—CONTRACTS FOR ELECTRICAL *equipment have taken a decided turn upward and the market carries a better tone than for several months past. Both central stations and industrials share in immediate commitments. Advancing activity in the iron and steel industry has registered a $600,000 contract for electrical apparatus.*

—RAILWAY ELECTRIFICATION *adds to the optimistic developments of the week and some promising business is in sight. Marine account continues under improved momentum and manufacturers of heavy machinery for that service anticipate some early commitments. Wire and cable shows better strength, and early spring business begins to give signs of life.*

The Pennsylvania Railroad will advance its electrification program by a sizable period of time and announces intention of completing the New York-Philadelphia improvement within 30 months, with estimated expenditure of $175,000,000 in that time. The work is estimated to require 60,000,000 lb. of copper for transmission, distribution and contact systems, as well as for other features of the work, including 2,500,000 lb. for transformers and other conversion apparatus. The program calls for the purchase of 240 electric locomotives and electrification of 80 passenger cars. Baltimore & Ohio Railroad is arranging a fund of $35,000,000 for 1931 expansion and improvements, a portion of the appropriation to be used for electrical requirements. Oregon Electric Railway has secured permission to build a 30-mile extension from Eugene to Squishlaw, Ore., with branch line to Panther, Ore., estimated to cost $1,231,000.

Elliott Company has tendered a low figure at $49,880 for a turbo-alternator unit for the Philadelphia, Pa., navy yard, other bidders being Westinghouse Electric & Manufacturing Company at $55,887, and General Electric Company at $58,798. Last noted company has secured an important contract from the Otis Steel Company, Cleveland, Ohio, for electrical equipment for a new continuous sheet mill, including two 4,000-kw. motor-generator sets, a number of heavy mill type motors, varying from 250 to 3,500 hp. rating, with complete control apparatus, switchboard equipment, etc., totaling about $600,000. Central Public Service Corporation, Chicago, has placed a construction contract for power dam and power house on the Sturgeon River, Mich., and will install two 1,600-hp. waterwheels for turbine units, with accessory equipment, entire development to cost $400,000. Aluminum Company of America, Pittsburgh, Pa., is the successful bidder for aluminum cable for a 736-mile transmission line for the city of Seattle, Wash., at a price of $737,155; Anaconda Wire & Cable Company, New York, the only other bidder, tendered a figure of $921,961 for copper cable.

CONSTRUCTION PROJECTS

Consolidated Gas Company, New York, plans equipment and service shop to cost more than $200,000. Bureau of Yards and Docks, Navy Department, Washington, D. C., plans improvements in power plant at New York navy yard to cost $80,000; also, improvements and extensions in power plant at Philadelphia, Pa., navy yard to cost $90,000, and improvements in electric system at same yard to cost $35,000. Abbots Alderney Dairies, Inc., Philadelphia, Pa., has filed plans for plant to cost $140,000. Pittsburgh & West Virginia Railroad Company, Pittsburgh, Pa., plans freight and passenger terminal at West Liberty, estimated to cost $1,000,000. Bureau of Yards and Docks, Navy Department, Washington, D. C., will make improvements in power plant at local navy yard to cost $25,000. Board of District Commissioners, Washington, D. C., will receive bids until March 5 for electric traffic light signal control apparatus, as per specifications on file.

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SOUTHEAST

—WHILE THE TONE *of business is looking up slightly from that existing in the past several weeks, it is not yet reflected in the volume of orders.*

A large company in Georgia last week ordered $5,000 worth of bare and weatherproof copper and $2,000 worth of aluminum wire, while one of the smaller companies in the same state ordered 38,000 lb. of bare and weatherproof copper wire. Some other power company orders are for $4,150 worth of steel pins, $2,350 worth of metering equipment, $2,000 worth of transformers and $3,220 worth of steel ties. Jobs are pending on wiring for airports in Alabama and North Carolina and airway beacons in South Carolina, the Alabama job involving $6,000 in wiring materials. These contracts will be let this week probably. An industrial in Florida placed an order for $2,500 worth of motors and an Alabama mill ordered loom motors and control equipment.

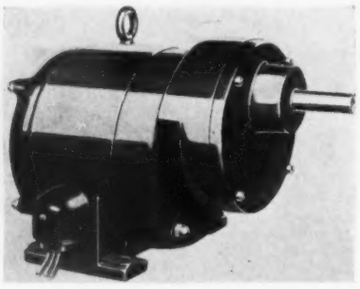
CONSTRUCTION PROJECTS

Bureau of Yards and Docks, Navy Department, Washington, D. C., plans extensions and improvements in boiler and plate shops, and woodworking plant at Norfolk, Va., navy yard, to cost $300,000. Page Power Company, Luray, Va., has secured permission to build a hydro-electric power plant on fork of Shenandoah River, reported to cost over $350,000. Martinsville, Va., plans extensions and improvements in power plant to cost over $100,000. Kentucky-Tennessee Light & Power Company, Bowling Green, Ky., contemplates power plant to cost over $1,000,000.

New Equipment Available

Parallel Shaft Type Master Geared Motor

A NEW MASTER GEARED head motor of parallel shaft type, built in sizes from 1/30 to 5 hp., single phase and direct current, has been announced by the Master Electric Company, Dayton, Ohio. It is of 1/30 to 20 hp. in the polyphase ratings, with interchangeable frames for the same horsepower and speed in different types of current.



This motor is equipped with antifriction bearings throughout, with precision ball bearings on the motor shaft and selected roller bearings on the countershaft. This construction permits of mounting in any position without change in construction. The gears are of the continuous tooth herringbone type. Where extreme quietness is essential, a composition gear, comparing favorably with steel in strength, can be supplied at slight additional cost.

Through the use of a unique oil seal arrangement, positive assurance against leakage is obtained, according to the manufacturer. Because of this feature, lubricant need be added only once in every thousand hours of operation.

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Inclosure for Open-Frame Type Electric Motors

A NEW ELECTRIC MOTOR INCLOSURE for use on any open-frame type motor to prevent the accumulation of dust, dirt and moisture on the motor has been announced by the Daun-Walter Company, Milwaukee, Wis. It consists essentially of a specially designed corrugated copper cover over the motor with steel end walls and supporting base plate. At one end of the inclosure a cooling fan and an outside combination guard and air deflector is provided. The cooling fan is mounted on the end of the motor shaft opposite the pulley end by means of a special shaft adapter. The adapter can be installed in a few minutes without disturbing the motor.

By means of the fan and the air deflector a single path of outside air discharges over the outside areas of the patented deep-fin corrugated copper construction over the motor, thereby carrying off the heat from the interior developed by the motor. The base plate is of heavy gage steel of box construction, in which the motor is placed, preventing the entrance of dirt, dust or moisture from below. The complete inclosure is so designed as to permit mounting on motor slide rails.

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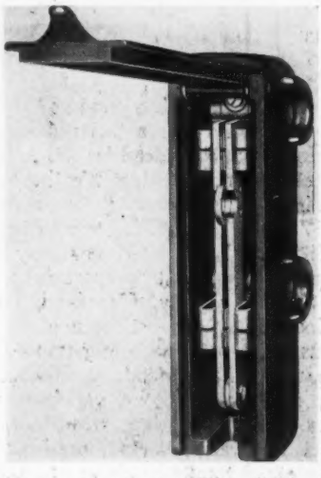
400-Amp., 7,500-Volt Disconnecting Switch

A NEW DISCONNECTING SWITCH with a rating of 400 amp., 7,500 volts has been announced by the W. N. Matthews Corporation. It has a blade consisting of two pieces of bus bar copper, $\frac{1}{4}$x$1\frac{1}{4}$ in. When in open position the blade is dead and is insulated from the contacts. The contacts are exceptionally large and are of the flat surface pressure type. They will not cause radio interference or undue heating.

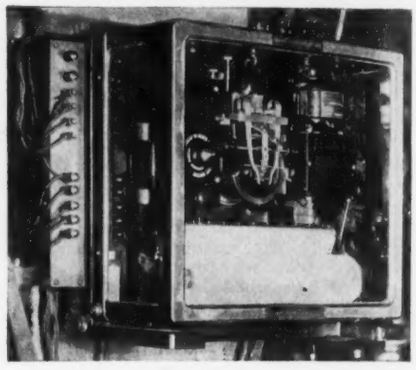
Terminals are of the cast copper clamp type and are clamped with $\frac{3}{8}$x$\frac{3}{4}$-in. slotted hexagon "Everdur" screws equipped to take either screwdriver or socket wrench. The terminals are designed to take a No. 4/0 stranded lead. For lead-in wires of smaller gage, brass



thimbles are supplied with an outside diameter the same as that of these thimbles. As the temperature rise of the terminal carrying 400-amp. is well below the melting point of the solder, there is no possibility of the solder in the thimble reaching the melting point.

Thermopile Measures Smoke Density

A SMOKE RECORDING installation consisting of a measuring chamber at the stack or breeching, a recorder at any convenient location and an indicator at the boiler has been announced by Leeds & Northrup Company, Philadelphia.



The measuring chamber, through which the smoke passes, contains a lamp at one end and a specially constructed, temperature-compensated thermopile at the other. Heat radiated from the lamp passes through the smoke-filled chamber and falls on the thermopile. With a constant heat source in the lamp, the amount of heat falling on the thermopile is inversely proportional to the density of the smoke. The heat from the lamp which reaches the thermopile causes it to generate a voltage. The measurement of this voltage is the measure of the smoke density.

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Quadrangle Rectangular Angle Reflector

A QUADRANGLE RECTANGULAR angle reflector the contour of which gives a straight-line cutoff of light instead of "scallops" shooting over the top of the sign or area lighted is announced by the Quadrangle Manufacturing Company, Chicago, Ill.

This reflector has been found suitable, it is claimed, for floodlighting of service stations, used car lots, production areas, where overhead lighting is impractical because of moving cranes, etc., barbecues, miniature golf courses, athletic fields and other outdoor uses, including sign lighting.

Q-D socket fittings, horizontal, vertical or outlet box type, keyless or pull socket, will fit this reflector, which is made in four sizes, ranging from 50 watts to 500 watts. With horizontal type socket fitting this reflector is reversible.